

U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF SOILS—MILTON WHITNEY, Chief.

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# SOIL SURVEY OF CANADIAN COUNTY, OKLAHOMA.

BY

E. H. SMIES.

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HUGH H. BENNETT, INSPECTOR, SOUTHERN DIVISION.

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[ Advance Sheets—Field Operations of the Bureau of Soils, 1917. ]



WASHINGTON:  
GOVERNMENT PRINTING OFFICE.  
1919.

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## LETTER OF TRANSMITTAL.

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF SOILS,  
*Washington, D. C., December 31, 1918.*

SIR: In the extension of the soil survey in the State of Oklahoma during the field season of 1917, a survey was begun and completed in Canadian County.

I have the honor to transmit herewith the manuscript report and map covering this work and to request their publication as advance sheets of Field Operations of the Bureau of Soils for 1917, as authorized by law.

Respectfully,

MILTON WHITNEY,  
*Chief of Bureau.*

Hon. D. F. HOUSTON,  
*Secretary of Agriculture.*



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### MAP.

Soil map, Canadian County sheet, Oklahoma.



# SOIL SURVEY OF CANADIAN COUNTY, OKLAHOMA.

By E. H. SMIES.—Area Inspected by HUGH H. BENNETT.

## DESCRIPTION OF THE AREA.

Canadian County is situated just west of the center of the State of Oklahoma, its eastern border lying 8 miles west of the city of Oklahoma. The area of the county is 891 square miles, or 570,240 acres.

The included territory is a part of the Great Plains region. The surface was originally that of a smooth plain, and the present relief is the result of erosion and of eolian deposition. The upland is predominantly undulating to gently rolling. South of the Canadian River, immediately north of this river west of Heaston, and south of Mustang are large rolling areas, but these are nowhere strongly rolling or broken except south of the Canadian River along its tributaries and those of Washita River. Erosion has been more active here than in any other part of the county, and many of the small creeks have cut down 100 to 175 feet into the red sandstone, forming narrow V-shaped valleys. The remainder of the rolling section of the county has distinct but rather broad V-shaped valleys, with smooth, narrow intervening divides. That part of the county just north of the North Fork of the Canadian River, from Concho west, rises gently from the flat river flood plain to a rather flat or very gently undulating divide. This averages 3 miles in width and drops off gently to the undulating prairie to the north.

The remainder of the county, which is undulating to gently rolling, has broad, V-shaped valleys and rather broad, smooth divides, the more moderate relief being due to the resistance to erosion of the shales and sandstones underlying this part of the county.

The alluvial lands along the streams include terraces or second bottoms, representing old flood plains and now standing above the level of overflow by the streams, and the present flood plains or first bottoms, most of which are subject to overflow. High terraces occur along the Canadian River and its North Fork, being quite extensive along the latter. These benchlike areas are for the most part level to very gently undulating, and are dissected only where traversed by

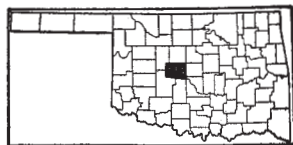


FIG. 1.—Sketch map showing location of the Canadian County area, Oklahoma.

streams issuing from the uplands. They occur as broad, flat areas, as narrow, flat strips of irregular outline, and as discontinuous remnants. The lower or first bottoms, which occur along nearly all the larger streams, are more uniform in development. They include the lowest lying flood plains and some slightly higher first bottoms that are inundated only at rare intervals. The surface is in general level, but interrupted in places by the valleys of tributary streams and by old channels.

In elevation above sea level Canadian County ranges from about 1,060 feet, in the extreme northeast corner, to about 1,590 feet at Geary on the western county line. Most of its area lies between 1,300 and 1,450 feet above sea level. There seems to be little difference in elevation between the Canadian River and its North Fork, each leaving the county at about the 1,200-foot level. The elevation at Yukon is 1,296 feet, at El Reno 1,359 feet, and at Calumet, which is on a high terrace, 1,377 feet. These towns are all close to the North Fork. The elevation at Union is 1,334 feet, at Okarche 1,239 feet, and at Piedmont 1,192 feet. There is a general slope toward the east and southeast. Canadian County is drained by four of the parallel streams that cross western Oklahoma in a southeastward direction. The two most important are the Canadian River and its North Fork. The Canadian River, which crosses the southwestern part of the county, has a channel varying in width from less than one-fourth to nearly three-fourths mile, but there is seldom water in the channel throughout the entire year. The Canadian River drains about one-fourth of the county. Practically all its tributaries are very short and, except in the central part of the county, have a steep gradient.

Nearly one-half of the county is drained by the North Fork of the Canadian River which flows through the middle of the county. Its tributaries from the north do not average over 2 to 2½ miles in length, while those from the south average about 6 or 7 miles. In the driest years the flow in the North Fork may stop entirely. The northeastern third of the county drains northward into the Cimarron River. Its most important tributaries in this county are John and Cottonwood Creeks. An area of about 8 square miles in the southwestern corner of the county drains southward into the Washita River.

Canadian County as a whole has been sufficiently dissected by erosion to have thorough drainage. The gradients of the drainageways in the broad undulating upland south of El Reno are rather low, but sufficient to carry off the average rainfall readily. Along the short tributaries to the Canadian River in the western part of the county, the drainage is excessive on some of the steeper slopes.

Canadian County was the fourth of the seven original counties formed when the Territory of Oklahoma was created in 1890. When

this territory was opened to homestead settlement in 1889 there was a great rush of immigrants, who came mainly from Kansas, Missouri, Nebraska, and Texas. The population has steadily increased, and in 1910 amounted to 23,501. In 1910 the rural population amounted to 15,629, an average of 17.5 persons to the square mile. Of the total population 823 were negroes and 416 Indians. The negro settlements are confined almost entirely to the sandier sections of the uplands, while the Indians are scattered over the whole county. Foreign-born persons, principally German, Austrian, and Canadian, constitute 5.6 per cent of the population, as compared with the percentage for the State of 2.4 per cent.

Fort Reno was the first white settlement in the county, but the first permanent town was El Reno, the present county seat, established in 1890. The smaller towns were not incorporated until 1901 or later. El Reno had a population of 7,872 in 1910. Yukon, in the east-central portion, and Geary, on the west county line, had populations in 1910 of 1,018 and 1,452, respectively. Other towns of local importance are Okarche, Piedmont, Richland, and Calumet, in the northern part of the county, and Union and Mustang in the southern. The population of each of these places is reported as less than 500. Each of the towns on the railroads has one or more grain elevators. There are two large flour mills at El Reno and one at Yukon, each with a daily capacity of nearly 1,000 barrels. El Reno has also a broom factory and a packing plant. There is a creamery at Okarche.

Except for the southwestern part, the county is well supplied with railroad facilities. The Oklahoma Division of the Chicago, Rock Island & Pacific Railroad, which extends north and south through the middle of the county, was completed in 1892. The Panhandle Division of the same system, traversing the county from east to west along the valley of the North Fork, was built in 1893, and thus the problem of transportation was relieved soon after settlement. The two lines mentioned give an outlet in all directions. In 1903 the present St. Louis, El Reno & Western Railroad was completed from Guthrie to El Reno. This line runs northeastward from El Reno, leaving the county at the northeast corner. The St. Louis & San Francisco Railroad crosses the southeast corner of the county. A stimulus to truck and dairy farming was given that section of the county along the North Fork east from the center of the county when the Oklahoma Railway built an interurban line from Oklahoma to El Reno in 1911. This line runs hourly trains and gives freight and express service at each section line it crosses.

Except in the rougher parts of the county the wagon roads conform closely to the section lines. In the prairie regions the roads are fairly good the year round, but some of those in the "sand hill" region and close to the Canadian River are too sandy to be used for heavy hauling in dry seasons. Except along the Canadian River

nearly all of the stream crossings are bridged. This river can be forded during much of the year, or crossed by ferries at Union or south of Mustang. The nearest bridge across this river is at Bridgeport, about 5 miles west of the county line.

Schools are located conveniently throughout the rural districts, and a number of consolidated schools have been established recently. Rural delivery of mail reaches all parts of the county, and good telephone facilities are available.

The principal markets for the surplus grain crops of the county are El Reno and Yukon. Most of the live stock is marketed at the city of Oklahoma, but a small portion reaches Wichita, Kans. Alfalfa, when shipped, usually goes to eastern Oklahoma or Texas points. The cotton is sent to markets farther south.

#### CLIMATE.

The mean annual temperature as recorded at the Weather Bureau station at Oklahoma, 8 miles east of the east county line, is 58.6° F. For the hottest months, July and August, the mean temperature is 79.8° and 75.7° respectively. For the coldest months, December, January, and February, the average temperature is 38.6°, 34.7°, and 38.5°, respectively. The highest temperature ever recorded here, 108° F., occurred in August, the lowest, -9° F., in January.

The summers are long and hot, but even the hottest days are tempered by the relatively low humidity and the prevailing breeze, and usually the nights are cool. Hot, dry winds from the south sometimes cause considerable damage to crops which otherwise could more readily withstand the occasional droughts. The winters are usually open and dry and would be quite pleasant except for the occasional occurrence of cold waves, or, as they are called, "northers." These periods usually last for two to five days, when suddenly the wind shifts to the south and the weather becomes normal. These cold waves cause some inconvenience in the handling of live stock.

At the Oklahoma station the highest monthly average velocity of the wind for the last 20 years is recorded as 14 miles per hour in April. The lowest average is recorded as 9 miles, occurring in August. The prevailing wind is from the south in all the months of the year except December, January, and February, when it is from the north, with occasional changes to the south. High winds during the planting season often inconvenience farmers in parts of the county and at times are injurious to the sprouting crops through the blowing about and drifting of sand. Tornadoes are of rare occurrence.

The average annual rainfall at Oklahoma is nearly 32 inches. There is a gradual decrease of about 2 or 3 inches as the west Canadian County line is approached. The highest rainfall occurs during the planting and growing season, while the winter months are com-



paratively dry. The snowfall is light. The lowest annual rainfall recorded is 17.27 inches or a little over one-half the normal; the total for the wettest year, 1915, was 38.63 inches. When the rainfall the preceding autumn has been heavy enough to put the subsoil in good condition the rainfall the following year nearly always suffices, owing to its generally favorable distribution. When rain is lacking at the critical time in the growing season, however, great damage may be done to crops, despite the general retentiveness of the soils, owing to the high summer temperatures and the rapid evaporation caused by the low humidity and active wind movement.

The average date of the last killing frost in the spring is April 2, and that of the first in the fall, November 1. There is thus an average growing season of 212 days. The latest killing frost in the spring on record occurred April 23 and the earliest in the fall on October 20. Planting usually begins about the first of March. Some farmers plant grain sorghums after the wheat crop has been removed, but this crop often does not have time to mature.

The following table gives the normal monthly, seasonal, and annual temperature and precipitation as recorded at the Weather Bureau at Oklahoma:

*Normal monthly, seasonal, and annual temperature and precipitation at Oklahoma, Oklahoma County.*

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1910).	Total amount for the wettest year (1915).
	° F.	° F.	° F.	Inches.	Inches.	Inches.
December.....	38.6	77	2	1.74	0.03	0.33
January.....	34.7	83	- 9	1.34	.89	.78
February.....	38.5	90	3	.98	.53	3.10
Winter.....	37.3	90	- 9	4.06	1.45	4.21
March.....	49.2	95	4	2.38	.65	2.08
April.....	59.6	90	25	2.80	4.31	7.50
May.....	68.1	95	33	5.75	2.72	3.69
Spring.....	59.0	95	4	10.93	7.68	13.27
June.....	75.7	106	52	3.07	1.09	7.23
July.....	79.8	106	55	2.65	.94	1.19
August.....	78.5	108	49	3.27	3.08	5.26
Summer.....	78.0	108	49	8.99	5.11	13.68
September.....	72.1	101	35	2.75	1.72	3.62
October.....	61.3	94	22	1.81	1.31	2.84
November.....	47.9	84	11	2.25	T.	1.01
Fall.....	60.4	101	11	6.81	3.03	7.47
Year.....	58.6	108	- 9	31.69	17.27	38.63

## AGRICULTURE.

Prior to the opening of this territory for settlement, in 1889, it was covered with a good growth of prairie grasses. Considerable timber, mainly cottonwood, elm, hackberry, black walnut, and oak grew along the streams and blackjack oak grew in the sandier regions of the upland. Some cattle were grazed during part of the year by "squatters" through agreement with the Indians. Immediately after the inrush of the settlers the sod was broken over a considerable part of the county and such crops were grown as were brought in by the various settlers. Those from the north and east grew corn, wheat, oats, rye, and potatoes, and those coming from the south planted cotton, corn, and sorghum. The early methods of cultivation were as varied as the number of farming regions represented among the settlers.

The marketing facilities created by the building of the railroads in the early nineties stimulated the production of money crops and the raising of live stock. As time went on the settlers improved their methods of cultivation and adapted their farming practices to the demands of the soils and the climate.

Until after 1900 the most important crops grown, named in the order of their importance, were wheat, corn, oats, hay, grain sorghums, and cotton. Cotton growing was confined mostly to the sandier sections. Soon after 1900 the farmers began to realize more and more the value of raising live stock on a large scale and corn growing and live-stock raising became the most important types of farming. Wheat soon became a crop of third importance. The extension of cattle raising was stimulated by the abundant prairie grasses, which supplied pasturage and winter feed. At the present time the agriculture of Canadian County consists of the production of general farm crops for home use and for sale, hog raising, beef-cattle raising and feeding, and considerable dairy farming. The leading crops over the county as a whole are corn, oats, wheat, prairie hay, alfalfa, grain sorghums, and cotton. In the bottom lands the most important crops are corn, oats, wheat, and alfalfa, while in the sandier regions corn, grain sorghums, and cotton are of foremost importance. On some of the sandier types in the eastern part of the county peach growing is becoming an important industry.

Corn occupies a larger acreage than any other crop. In the average year nearly all of the production is used locally in feeding live stock and any surplus is usually taken by the local mills. The principal varieties grown are Reid's Yellow Dent, Iowa Silver Mine, Dent Squaw, and Bloody Butcher. The Dent Squaw is recommended by the Oklahoma State Experiment Station for the upland. The 1910 census reports 161,693 acres of corn as compared with 56,130



acres in 1899. The average yield for the last 3 years has been 13 bushels per acre. Corn is more susceptible to seasonal variations than many of the other crops, and if rain does not come at the right time it is seriously damaged. In favorable years yields reach 50 to 60 bushels per acre on the better soils. Corn is generally grown on the bottom-land soils and on the lighter soils of the upland.

The crop of second importance is oats. The principal variety grown is the Texas Red Rustproof; the State experiment station also recommends the Early May. An area of 42,153 acres was reported in oats in 1909, with a production of 1,403,592 bushels. This is three times the acreage of the crop in 1899. The average yield for the last 3 years has been 21 bushels per acre. Owing to the cold spells that occur during most winters, only spring varieties are grown. Oats are produced generally throughout the county on nearly all types of soil. The crop is used locally, in most cases, in the feeding of work stock and young calves and pigs.

Wheat was the crop of first importance in 1899, when it occupied 119,928 acres, but it had dropped to third place by 1909, when it was grown on 27,449 acres and produced a total of 397,737 bushels. The respective acreages devoted to wheat and oats during the last 4 or 5 years have remained about the same. The average yield of wheat for the years 1915-1917 was 10.8 bushels per acre. Wheat is still the main money crop. The chief varieties grown are Turkey Red and Mediterranean, but the Kharkof variety also is recommended by the State experiment station. The soft varieties may occasionally freeze out in wet winters, but hard wheat seldom winter-kills. Wheat is grown most extensively on the heavier upland soils, where it gives the highest average yields. All the crop is used by the local mills.

The grain sorghums are the most certain crops for this region, as they yield some grain even in the driest years. The acreage devoted to these crops is steadily increasing. They were introduced about 1900, and in 1909 were grown on 2,827 acres, with a production of 29,114 bushels. While the acreage from year to year depends considerably upon the weather conditions, it is much greater now than in 1909. The average yield for the last 3 years was 17.1 bushels of grain per acre.

Probably 90 per cent of the area seeded to the grain sorghums consists of kafir, but feterita is gaining in popularity in some sections. The varieties of grain sorghums recommended for this county by the State experiment station are the Standard and Dwarf Blackhull white kafir, feterita, and darso. Some milo is grown. The sorghums are produced on all of the farming soils of the county, being used locally for feeding purposes.

Alfalfa has been grown since about 1895, but it has been important only since 1907. The 1900 census reports 694 acres in this crop, while the 1910 census gives 10,021 acres, with a production of 16,671 tons of hay. The State board of agriculture reports a slight decrease in the total acreage of alfalfa in the last few years. Alfalfa at the present time is grown mostly on the alluvial lands, and the largest fields are on the heavier types of soil. A stand of alfalfa is said to remain profitable for 8 years or more on the heavier types and for 4 years or more on the lighter soils. Much alfalfa hay is stored on the farm for feeding work stock and cattle, and the surplus is sold locally or shipped to points to the south or east.

Besides alfalfa, the principal hay crop, considerable hay from other cultivated and wild grasses is cut in Canadian County. The census reports 1,246 acres in tame grasses other than alfalfa in 1909, with a production of 1,323 tons of hay, and 15,549 acres in prairie grasses, which produced 7,988 tons of hay. There was also an area of 344 acres of grain cut green, giving 524 tons of hay. The average yield of prairie hay during the last three years has been about 0.7 tons per acre. Bluestem, buffalo grass, grama grass, bunch grass, and mesquite are the most important of the prairie grasses. In the drier years a large tonnage of crab-grass hay is cut from the wheat and oat stubble fields. In native pastures which have been grazed to any considerable extent the bluestem grass is often killed out. Sudan grass, the production of which is still in the experimental stage in this county, has given excellent results on nearly all the soils and is being grown more extensively each year. Two or three cuttings with a total average yield of about 3 tons per acre are obtained. Bermuda grass gives good results where sowed for pasture.

The census reports 2,562 acres of coarse forage cut in 1909, with a production of 4,671 tons. The forage crops include kafir, corn, feterita, and milo, ranking in order of importance as named. The total acreage of these coarse forage crops is much larger now than in 1909. The forage with the hay crops is used in the wintering and fattening of live stock.

Most of the cotton produced in this county is grown on the sandier soils, though the crop is planted in a small acreage on nearly all the important types. The varieties recommended for this region by the State experiment station are the Triumph and the Acala. The area in cotton in 1909 was 6,655 acres and the production 1,594 bales, or one-fourth bale per acre. Since 1909 cotton growing has declined rapidly. In 1917 only a small acreage was planted. This county is far enough north to have escaped the boll-weevil menace, but it also lies near the northern limit of profitable production and fall frosts damage the crop in some years. Considerable injury is also

done by high winds during the blooming stage and by the attacks of the bollworm (sharp-shooter).

The value of the animals sold or slaughtered in Canadian County in 1909 was \$1,502,702. According to the State enumeration the number of all cattle in the county in 1917 was 30,743. Some relatively small cattle ranches exist, but most of the cattle are raised on the ordinary farm in rather small herds. The most popular beef or dual-purpose breed is the Shorthorn; the Holstein and Hereford are the only other breeds of much importance. There are probably 15 prominent Shorthorn herds in the county. Besides the stock raised locally many carloads of "feeders" are annually shipped in for fattening. These cattle are usually obtained at the city of Oklahoma and originate chiefly in western Texas. Cattle are usually kept on prairie-grass pasture throughout the summer and finished during the winter months on prairie hay, alfalfa, the various fodder crops, and corn. Corn fields are often used for early winter pasturing after the removal of the grain and the wheat fields are in many cases pastured before the growth has been checked by frost. Some silos are used to store feed for beef cattle. The ensilage consists chiefly of corn and grain sorghums.

Increased attention is being given to dairying. In 1909, \$162,661 worth of dairy products were sold from the farms. The building of the interurban railway from El Reno to Oklahoma in 1911, the building of a creamery at Okarche, and the increasing demand for dairy products at El Reno have combined to stimulate dairy farming in recent years. Except in the vicinity of El Reno and along the interurban lines, dairying is still a subordinate interest on the farms, although nearly every farm has a few milch cows and has some surplus dairy products for sale. The number of milch cows in the county in 1917 is reported as 8,971. The pure-bred dairy herds are composed principally of Jersey, Holstein, or Shorthorn cattle. Dairy cattle are usually kept on prairie-grass pasture in the summer and fed on prairie or alfalfa hay with a supplement of grain during the winter. Some of the dairy farms are equipped with silos.

Hog raising is an important industry throughout the county. The number of hogs in the county in 1917 was 24,186. The only important breeds are the Duroc-Jersey and Poland-China. On many of the valley farms and some of the upland farms the hogs are pastured on alfalfa. Elsewhere they are turned into wheat fields, as well as corn and grain-sorghum fields, in the fall and winter, but get little succulent feed during the summer months. They are fattened and finished chiefly on corn, with some highly nitrogenous supplement.

The State board of agriculture reports 1,080 sheep and goats in the county in 1917. The number of horses in the county the same

year is given as 12,884 and the number of mules as 3,319. Nearly every farmer raises one or more colts each year. The most popular breed of horses is the Percheron. A ready market for all suitable surplus stock is available nearly always at the Fort Reno Remount Station.

The total income received from the sale of poultry and eggs in 1909 was \$286,087. Poultry raising is much more important than this figure indicates, as it does not take into account the large quantity of poultry products consumed in the farm homes. Nearly every farmer raises a good-sized flock of chickens and many of them raise turkeys and geese in addition. There are many flocks of pure-bred chickens in the county.

Considerable attention has been given in recent years to fruit growing, especially on the sandier soils in the eastern part of the county, where a ready market can be found in the city of Oklahoma. Peaches are the most extensively grown fruit. The 1910 census reports 105,685 peach trees, 62,263 apple trees, 85,264 grapevines, 9,544 plum trees, 7,454 cherry trees, and 7,200 pear trees in the county. In the same year there were 55 acres of blackberries and 7 acres of strawberries. All these fruits do well except in exceedingly dry years, when some of the late varieties may be damaged. Peaches, apples, and some grapes are shipped out of the county. The chief variety of peach is the Elberta. A few peach orchards, each including as much as 40 or 80 acres, have been set out recently in the vicinity of Mustang and about 16,000 bushels of fruit are reported shipped in the average year from that station. Most of the peaches are shipped to St. Louis and eastern points. The principal varieties of apples grown are the Jonathan, Winesap, Missouri Pippin, and Ben Davis. From Mustang there is shipped an average of 6,000 bushels of apples annually. Many of the farms in all sections of the county produce enough fruit for home use.

Watermelons, cantaloupes, and sweet potatoes are grown for sale in a small way on the sandier soils in the eastern part of the county, especially near Mustang. Many farms in every part of the county produce some Irish potatoes, sweet potatoes, and melons, but in the drier years considerable difficulty is experienced on the heavier soils in bringing sweet potatoes and melons through the dry spells, unless the soil is carefully handled. The total production of Irish and sweet potatoes is not sufficient to supply the home demand, and many carloads are shipped in annually. Most of the sandier soils of the county give excellent yields of these crops. The leading variety of watermelons is the Tom Watson; of cantaloupes, the Rocky Ford; of sweet potatoes, the Nancy Hall. About 75 carloads of watermelons and 10 of cantaloupes are shipped from Mustang annually. The varieties of Irish potatoes recommended for the county by the State experiment station are the Early Ohio and Triumph.



Peanuts are not grown on a large scale, although they give excellent results in the sandier sections. Nearly every farm here grows a few rows of peanuts for home consumption, and many farmers are beginning to grow them for live-stock feeding. The only kind grown is the Spanish. Broom corn was reported on 144 acres in 1909, with an average yield of 279 pounds per acre. It does fairly well on the loamy soils, but is not as profitable as some of the other crops on account of the scarcity of labor. Rye and barley are grown on a small scale for fall pasturage and for the feeding of young stock. Cow-peas are becoming more important as a late summer crop. The varieties recommended by the State experiment station are the Whippoorwill, California, White, Blackeye, and New Era. Considerable sorghum is grown each year for the production of sirup for home use.

Small grains are produced largely in those parts of the county which have the heavier types of soil. Not only are such soils adapted to the crop, but their topography is usually gently undulating to very gently rolling, permitting the efficient use of tractors and heavy implements. The sandier soils in the more rolling sections are devoted to a more generalized system of farming, in which stock raising and feeding are more important. The smoother areas are used for the general farm crops and the rougher areas as pasture land. Good grazing is available in all the rougher sections, even on slopes that are too steep or stony to be plowed.

Alfalfa is grown most extensively on the Miller soils and the heavier members of the Canadian and Yahola series, the farmers recognizing these types as being well adapted to this crop. Although they are used also for alfalfa, the other bottom-land soils are more extensively devoted to corn, wheat, and oats. The Calumet soils are recognized as better adapted to small grains and sorghums than to corn and alfalfa. The heavier flood-plain soils are known to have a tendency to produce straw at the expense of the grain in wet years. In the upland the Kirkland soils and the heavier Vernon soils are recognized as better for small grains than the Derby soils and the Derby and the lighter Vernon soils as better suited to corn and cotton than the Kirkland and heavier Vernon types. The more rolling areas of the Derby and Vernon soils are considered better suited to cattle raising than to any other agricultural use. The sandy soils of both the upland and bottom land are recognized as best adapted to sweet potatoes, melons, peanuts, fruits, and truck crops generally, and they are locally chosen for these crops.

Corn is usually planted with a lister on unplowed land, but some farmers break the ground with a lister the preceding fall, if the corn is to follow wheat or oats, to increase the absorption of the rainfall. Corn usually occupies land that was in corn, wheat, or sorghum the preceding year. The crop is planted between March 25 and May 1,

depending upon the temperature and moisture conditions. It is usually worked with a weeder and given two or three cultivations. In harvesting it is husked from the stalk, the fields subsequently being pastured. A part of the crop is used to fill silos. Very little corn is "hogged down" in the average year. The growing of cow-peas between the corn rows has proved profitable in years of normal rainfall.

Ground to be sown to wheat is usually plowed early to a depth of 4 or 5 inches. This is followed by one or two harrowings and as many diskings as are necessary to keep the soil in good condition and to prevent the formation of a crab-grass sod. Some farmers seed wheat on ground that has been prepared by disking it once or twice. Wheat is usually sown between September 20 and November 1, depending upon the moisture conditions. As a rule it follows oats, but the crop is often seeded between the rows of a sorghum or corn crop. The best results are obtained by early and deep plowing. Wheat is usually pastured during the fall and much damage may be done when the ground is either too wet or too dry through the tramping of the stock and the pulling out of the plants. The grain is cut either with a binder or a header and is thrashed from the shock or from the stack.

Oats are seeded generally between February 10 and March 10 on land that has been prepared in much the same way as for wheat. The crop usually follows corn or a grain sorghum. Kafir, feterita, and milo are generally put in with a lister, although some kafir, intended for forage, is seeded with a drill. The listed crops are cultivated in much the same way as corn. The grain sorghums are planted at various times up to the middle of summer, in some cases being seeded on ground from which wheat or oats has just been removed. They are grown most extensively in years when the maturing of a good crop of corn seems doubtful. Cotton is usually put in with a planter on ground that has been prepared in much the same way as for oats and early cultivation is done with corn cultivators.

The best results with alfalfa have been obtained when the crop is sown in the spring on a well-prepared seed bed. Some farmers seed alfalfa with oats as a nurse crop, which has given good results. In this county inoculation is rarely practiced and is seldom necessary. If the crop is sown in the fall when the moisture conditions are not favorable it is likely to be insufficiently developed to withstand the early fall frosts. On the other hand the growth of weeds is likely to injure the spring seeding. Alfalfa gives from three to five cuttings a year. Most of the alfalfa is baled as soon as cured.

Modern implements are used in all farm operations. Not much attention is paid to the care of machinery when not in use. The

heavier soils in the more level sections are plowed with 5-horse teams and tractors, the lighter soils with 4-horse teams. Mules are used on many farms for the heavy draft work.

Not much attention has been given in the past to the rotation of crops, and even now systematic rotations are followed on comparatively few farms. This is probably due to the newness of the fields and to the fact that weather conditions in many years discourage the rotating of crops.

Practically no commercial fertilizers are used in Canadian County at present. Eleven farmers reported a total expenditure of \$446 for fertilizers in 1909. In the past little effort has been made to utilize barnyard manure, but the value of applying this to the soil has in recent years become more fully recognized by the farmers. Even now they value manure more for its effect in increasing the moisture-holding capacity of the soil than for the plant food it contains.

Farm labor is rather scarce. Under the prevailing system of general farming and stock raising there is a demand for labor the year round. Laborers receive \$30 to \$35 a month, with board, washing, and the use of a horse. Day laborers during grain harvest are paid \$2.50 to \$3 a day. Little labor is employed to pick cotton, the farmer and his family usually caring for this crop. Some agricultural undertakings on a large scale, such as the growing of broom corn, are held to be unprofitable because of the scarcity and high cost of labor.

All the land in Canadian County has been taken up under the homestead laws or is in the hands of Indians, hence the original size of practically all the farms was 160 acres. While many of the homesteads have been sold and in some cases combined with others, the great majority of the farms are still of this size. According to the 1910 census the next largest number of farms contain between 260 and 499 acres. The average size of all farms in 1910 was 206.8 acres. In the northeast corner of the county, where wheat is by far the most important crop, some farmers rent considerable land in addition to what they own, often cultivating several hundred acres. In the rougher and sandier sections, where grazing is probably the most profitable industry, tracts including several hundred acres are devoted to cattle ranching.

According to the 1910 census 56.4 per cent of the farms are operated by owners. Cultivated land is usually rented on the crop-share basis and hay or pasture land for cash. The usual rent under the share system is one-third of the grain and one-fourth of the cotton, delivered at the nearest market. Pasture and mowing land, when included with tenanted farms, rents for \$1 to \$2 an acre. Cash rent for cultivated land varies from \$2 to \$4 an acre, but very little

land is leased on this basis. Large tracts of land rented for grazing purposes bring about \$1 an acre.

The farms in the vicinity of the larger streams and on the prairie soils are fairly well improved, usually with a well-built house, a large barn, and several smaller outbuildings. Most of the farms are fenced with barbed wire and many, especially in the sections where alfalfa is grown, with woven wire. Improved upland prairie soils range in price from \$30 to \$80 an acre, and improved bottom-land farms from \$60 to \$125 an acre. Sandy upland farms in the rougher sections of the county bring \$15 to \$75 an acre. Land values in all cases vary according to the distance from market, the topography, the soil, and the improvements.

#### SOILS.

Canadian County lies in the Great Plains region, which extends from western Texas through Montana and North Dakota into Canada. The upland soils of the county may be classed in two general divisions, residual prairie soils and soils largely of wind-blown origin.

The residual prairie soils are derived from the underlying red sandstones and shales, which form part of the extensive Red Beds of this region. They are usually calcareous. The Red Beds are said to average about 3,000 feet in thickness in this county.<sup>1</sup> Their upper portion belongs to the Permian age and the lower probably to the Pennsylvanian. The outcropping rocks of Permian age belong to three formations, the Woodward, Blaine, and Enid.<sup>2</sup> The Enid formation occupies about two-thirds of the county, in the northeastern part. The surface rocks are for the most part red shales, with soft lenticular red sandstones. Lime concretions occur in places. At about 100 feet below the surface the shales are quite salty in places. The thickness of the formation is estimated at 1,200 to 1,500 feet. The Blaine formation occupies a very narrow strip entering the county about 8 miles east of the northwest corner and extending southeasterly to a point about 6 miles north of El Reno. It contains ledges and outcrops of gypsum, in some places extensive enough to be mined on a small scale, as 2 miles east of Nemack. The formation is 75 to 100 feet thick. The Woodward formation occupies the remainder of the county. It contains ledges of dolomite in its lower depths. The rocks of all these formations dip at a rather low angle to the southwest.

The sandstones of these formations are usually composed of very fine, rounded grains and are cross-bedded to a pronounced degree. In places they grade into shales in very short distances, but more

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<sup>1</sup> Bul. No. 11, Oklahoma Geological Survey, pp. 107-111.

<sup>2</sup> Bul. No. 19, Part II, Oklahoma Geological Survey, pp. 65-67.



often there is a distinct line between the two, the shales containing little consolidated very fine sand. The shales are usually very fine grained and very plastic, with a high shrinkage upon drying. In a few places in the northeastern corner of the county and in that portion occupied by the Blaine formation the soil is very shallow over the shale deposits. In the areas of both formations there are washed-out places where the clayey shale is exposed in an unweathered condition and supports but a scant growth of vegetation.

The areas occupied by the Enid and Blaine formations are quite level, with few or no deep erosional channels. The shales upon exposure are slow to weather into soils. The Woodward formation, on the other hand, is characterized by short erosional channels, in places as much as 125 to 250 feet deep, as the sandstones of this formation weather into soils quite rapidly.

A small amount of gravel occurs on the tops of a few hills in the south-central part of the county occupied by the Enid formation. Owing to the inextensive occurrence of these gravels, which are supposed to belong to the Tertiary age, they do not give rise to soils different from those originating from the Permian rocks.

The residual soils derived from the Red Beds are classed in two series. The chocolate-red soils with chocolate-red, rather friable subsoils are correlated in the Vernon series and the brown to dark-brown soils with brown to chocolate-brown, claypan subsoils in the Kirkland series. The latter occupy the more nearly level uplands, while the Vernon soils occupy more rolling country.

The wind-blown soils of the upland are classed in the Derby series. The surface soils are brown to reddish brown with yellowish to reddish, friable subsoils. These soils are composed for the most part of material blown up over the uplands from near-by alluvial flood plains and hence their most typical development in this general region is in the proximity of the larger streams. In this county, however, considerable areas of these soils occur several miles inland, where no doubt the surface soil is of a wind-blown origin and the subsoil to a certain extent residual. The series is composed only of the sandier types. That portion of the area of this series immediately north of the North Fork, from Concho west, is classed geologically with the sand hills region of the State.

The alluvial bottom-land soils may be divided into two general divisions, terrace or second-bottom soils, and the more recent alluvial or first-bottom soils. Of the former three series occur in this county, all of which represent material laid down by the streams at some remote time, when they flowed at higher levels than at present. The material has been washed from prairie soils of this region and other regions farther up the streams. The Canadian series includes brown

to dark-brown soils, usually with friable, yellowish subsoils. The Calumet series includes brown to dark-brown soils with brown to chocolate-brown, claypan subsoils. The Reinach series, having a brown to dark-brown soil with a brownish-red subsoil, includes chiefly material washed from the Permian Red Beds.

The recent-alluvial soils, which occupy the present stream flood plains are divided into three series. The brownish-red soils with lighter textured subsoils are correlated in the Yahola series. Similarly colored soils with rather heavy subsoils belong to the Miller series. Both of these series include soils derived by stream wash from the Red Beds. The darker colored first-bottom soils are included in the Lincoln series. Practically all of the area occupied by these three series is subject to overflow.

In the following pages of this report the various soils of Canadian County are described in detail and their relation to agriculture discussed. Their distribution is shown on the map accompanying this report. The following table gives the name and the actual and relative extent of each type mapped:

*Areas of different soils.*

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Derby very fine sandy loam.....	89,984	16.1	Kirkland clay loam.....	9,920	1.7
Steep phase.....	1,472		Vernon clay.....	512	1.6
Vernon very fine sandy loam.....	84,096	15.8	Eroded phase.....	8,768	
Steep phase.....	6,464		Lincoln silt loam.....	8,448	1.5
Kirkland silt loam.....	47,616	8.4	Lincoln clay.....	6,336	1.1
Derby fine sandy loam.....	46,848	8.2	Derby fine sand.....	6,272	1.1
Kirkland loam.....	45,312	7.9	Canadian clay.....	5,056	1.0
Canadian very fine sandy loam....	27,328	5.4	Poorly drained phase.....	.704	
Colluvial phase.....	3,584		Yahola silty clay loam.....	3,712	0.9
Kirkland very fine sandy loam....	26,816	4.7	Heavy phase.....	1,344	
Calumet very fine sandy loam.....	25,408	4.5	Vernon loam.....	4,736	0.8
Derby loam.....	19,392	3.4	Canadian very fine sand.....	4,608	0.8
Vernon clay loam.....	15,296	3.1	Rough stony land.....	2,176	0.4
Eroded phase.....	1,984		Calumet silt loam.....	1,728	0.3
Lincoln very fine sandy loam.....	16,320	2.9	Miller clay.....	1,600	0.3
Yahola very fine sandy loam.....	13,888	2.4	Reinach very fine sandy loam.....	640	0.1
Dunesand.....	11,072	1.9			
Lincoln very fine sand.....	10,752	1.9			
Canadian loam.....	10,048	1.8	Total.....	570,240	-----

KIRKLAND VERY FINE SANDY LOAM.

The Kirkland very fine sandy loam consists of 6 to 8 inches of brown very fine sandy loam overlying brown loam or fine sandy loam to clay loam which passes rather abruptly into a tough, brown clay at 16 to 24 inches. The lower subsoil is reddish on some of the steeper slopes. At the base of slopes the surface soil is in places 10

to 12 inches deep. Along the contact with areas of Kirkland silt loam or loam, the surface soil becomes more silty and the boundary line between the types very indefinite. In the more rolling sections and in the breaks to the streams are some areas in which the claypan stratum lies at greater depths than typical and where the transition from the lighter upper subsoil to the claypan is not as abrupt.

The largest continuous bodies of the Kirkland very fine sandy loam occur in the northern tier of townships, though areas ranging from 80 to a few hundred acres are scattered over the eastern two-thirds of the county. The type usually has an undulating to gently sloping topography. It often occurs at the base of slopes from the higher lying Derby very fine sandy loam, or on long gradual slopes from hills or ridges of Vernon very fine sandy loam. Surface drainage is good, but the underdrainage is slow, owing to the rather impervious nature of the lower subsoil.

This is an important soil agriculturally. Most of it is under cultivation, the remainder being used for pasture. The same crops are grown as on the Kirkland silt loam, except that the acreage in cotton is relatively larger. The soil is easier to handle than the silt loam, but is more subject to wind erosion. Wheat yields an average of 7 to 10 bushels, oats 20 to 30 bushels, kafir 15 to 25 bushels, and corn 12 to 17 bushels per acre.<sup>1</sup> Alfalfa is a rather uncertain crop. It usually starts well and gives good yields, but a succession of two or more dry seasons greatly decreases the yield.

Land of the Kirkland very fine sandy loam sells at an average price of \$50 to \$75 an acre, depending upon the improvements and distance to market.

The suggestions made for the improvement of the Kirkland silt loam and loam are equally applicable to this type.

#### KIRKLAND LOAM.

The typical Kirkland loam consists of a brown to dark-brown loam, passing at 8 to 10 inches into lighter brown, heavy loam, clay loam, or silty clay loam, which is abruptly underlain at 15 to 20 inches by a tough, heavy clay of a brown or chocolate-brown color. In places there is a relatively large proportion of very fine sand in the surface soil, but it always contains enough clay to have a loam texture. In other places there are a few inches of very fine sandy loam at the surface. A heavy clay substratum of reddish-brown to chocolate-red color may be encountered in the lower subsoil, especially on the steeper slopes and in the northeastern corner of the county. Both soil and subsoil typically do not effervesce with hydrochloric acid, but the reddish material encountered at or near 3 feet below

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<sup>1</sup> Statements as to crop yields are based on reports of farmers.

the surface, in many places contains enough lime carbonate to effervesce freely.

The Kirkland loam is mostly residual from the sandstones and shales of the Permian Red Beds, though on some of the hill crests and breaks of the divide between the Canadian River and its North Fork narrow strips may occur where the soil is derived in part from Tertiary material. Here the soil varies from typical in having about 6 inches of brown loam on the surface, underlain by brown to reddish-brown, friable, heavy loam to light clay loam, which in turn is underlain at about 20 inches by a light-brown or reddish-brown or in places reddish, tough clay. The lower subsoil is in places calcareous. When this variation occurs on the hill crests some coarse sand and gravel or small pebbles may be present, though never in sufficient quantities to interfere seriously with cultivation. The soil of this variation is very limited in extent, the areas in places reaching a few hundred feet in width and rarely over a quarter of a mile in length.

Where the type occurs along breaks to small drainage ways, the surface soil in many places is quite shallow and the reddish substratum comes nearer to the surface, being exposed in small eroded patches. Small areas of this soil occur in the more rolling sections where the brownish clay loam subsurface material is turned up in deep plowing.

The largest bodies of Kirkland loam occur south of El Reno from Heaston eastward to within 5 or 6 miles of the east county line. Several areas varying in extent from 40 to 1,000 acres are scattered over the northeastern fourth of the county and to the west of Okarche.

The Kirkland loam as a rule occupies more rolling areas than the silt loam, its topography varying from undulating to very gently rolling. Where it is associated with the silt loam it usually occupies the gentle slopes to streams or lies on minor elevations. Where it occurs within areas of the Vernon or Derby soils it usually occupies the flatter areas. The surface drainage is good, and the subsurface drainage is somewhat better than that of the Kirkland silt loam, though insufficient on account of the hardpanlike structure of the lower subsoil.

The Kirkland loam is an important soil. It is much easier to handle than the Kirkland clay loam and is more desirable for general farming. The same crops, ranking in the same order of importance, are grown as on the silt loam, and practically the same yields are obtained. Considerable prairie hay is cut, with an average yield of about 0.7 ton per acre. Fruits, especially apples, do well, and more attention should be paid to the planting and care of farm orchards.

Land of the loam type is held at about the same prices as the Kirkland silt loam, ranging from \$60 to \$90 an acre, the latter price being for the most favorably situated tracts.

Cultivated areas of the Kirkland loam are lower in organic matter than the Kirkland silt loam, and in order to increase the productiveness and the water-holding capacity cowpeas should be grown and part of the crop turned under or liberal applications of barnyard manure made. Especial attention should be given to those practices which assist in the absorption of moisture, such as early and deep plowing and maintaining an effective soil mulch during the summer.

#### KIRKLAND SILT LOAM.

To the depth of 8 to 10 inches the Kirkland silt loam is a dark-brown to brown silt loam, moderately high in organic matter and containing in many places, especially in the more rolling areas, a relatively large proportion of very fine sand. The subsoil to a depth of 15 to 22 inches is a dark-brown to chocolate-brown silty clay loam, abruptly underlain by a tough heavy clay, having about the same range in color as the overlying material. This tough clay stratum usually continues to depths below 3 feet, where it generally overlies a chocolate-red to dark chocolate red layer of partly weathered or unweathered shale or shaly material. In places, especially on or near slopes, this chocolate-red material, which is also tough and impervious, occurs within the 3-foot section. Neither soil nor subsoil is calcareous, according to the acid test, until the lower layer is approached.

On the more nearly level areas of this type roundish spots, about 50 feet in diameter, may occur, in which the soil is brown in color and a silty clay loam in texture. These spots represent exposures of the subsurface soil, but they are too few in number and usually too small to warrant separate mapping. In the northeastern part of the county the subsoil frequently becomes a dark chocolate red below 24 to 30 inches, but this substratum retains the typical tough structure and is usually calcareous.

The Kirkland silt loam forms the soil over much of the nearly level prairie upland. Several rather large areas occur north and east of Piedmont and west of Okarche, but the principal bodies lie to the south of El Reno from Heaston eastward to within 5 or 6 miles of the east county line. The general elevation above sea level ranges from 1,350 to 1,400 feet. The surface is usually very gently undulating and some parts of the larger areas resemble a very high terrace or table land.

This soil is drained by a system of intermittent waterways which have rather low gradients, and although the surface drainage over



most of the type is rather slow, it is adequate in most seasons. Very little of the type is excessively drained. The underdrainage is very poor, owing to the rather impervious nature of the tough clay or claypan subsoil, locally known as "hardpan." This is consequently one of the last soils in the county to warm up in the spring. The dense subsoil also retards the absorption of moisture and prevents its circulation to meet the needs of growing crops.

The Kirkland silt loam is a rather important type. It originally supported a luxuriant growth of prairie grasses and patches of the virgin sod still remain on nearly every farm, such areas being used for pastures. The native prairie grass consisted chiefly of bluestem, buffalo grass, grama, mesquite, and a variety of "bunch" grasses. After being pastured for a few years the bluestem disappears and the principal growth is mesquite. This furnishes excellent pasturage until after the fall frosts, provided it gets enough moisture to make a good growth in early summer.

The principal crops on this soil are wheat, oats, kafir, and corn. Some cotton is grown, fairly good yields being obtained. In the vicinity of the towns dairying is carried on in a small way, the cows being pastured in the summer months and fed on hay and some concentrates in the winter. Pasturing on the crab grass that grows in oat and wheat stubble is a common practice. Hog raising is the most important live-stock industry, but little attention is given to summer-pasturage crops for hogs.

This is a fairly good wheat soil and in years of ample rainfall it yields as much as 20 to 25 bushels per acre. The average yield has ranged in the last few years from 8 to 11 bushels. The best yields are obtained on land that has been well prepared early in the season. Oats do well in years of normal rainfall, yielding 20 to 30 bushels per acre. Kafir ordinarily yields 18 to 25 bushels of grain per acre, besides which a large amount of fodder is obtained. This soil is fairly well adapted to corn and produces good yields in favorable seasons, especially of the Dent Squaw variety, but when the rainfall is light or fails to come when needed the yields are very materially reduced. The ordinary yield is between 12 and 16 bushels per acre.

Alfalfa is given little attention on this soil, though a few small fields have been producing fairly good yields for several years. If planted on a well-prepared seed bed and favored with the right moisture conditions, alfalfa in most places starts well and gives good yields for a few years, or until an exceedingly dry season, when the stand becomes too thin to be profitable. This is probably due in part to the tough, compact subsoil and the underlying strata of unweathered shale and in part to the relatively great depth to water. Sudan grass, while a comparatively new crop, has given good results, from 3 to 3½ tons of hay per acre being obtained.

The growing of fruit for home use has been neglected by most farmers, but those who have given a little care to their orchards have had excellent results, especially with apples.

The Kirkland silt loam is quite readily kept in good tilth, and while it is somewhat subject to wind erosion it does not drift nearly as badly as the lighter textured soils. It does not require as heavy draft in tillage operations as the finer textured members of the Kirkland series. The application of barnyard manure, which is becoming more common among progressive farmers, has proved beneficial to this soil, improving in a marked degree its moisture-retaining capacity. A soil mulch is easily maintained in fields of this type.

Farms composed of the Kirkland silt loam sell at \$60 to \$90 an acre, depending on the location with regard to markets and the state of the improvements.

While the soil is quite productive in seasons of normal rainfall, long continued cropping may diminish the yields. Too little attention has been given to improving the moisture condition. For soils of this nature the Extension Division of the Oklahoma State Agricultural Experiment Station recommends a rotation including wheat, oats, a grain sorghum, and cowpeas. Corn may be introduced in this rotation. The wheat should be followed by cowpeas if moisture conditions are favorable, the latter crop may be used either for hay or as a green-manure crop. If the cowpeas are used for green manure a grain sorghum probably should be the next crop, then corn, if corn is to be used in the rotation. It would seem advisable to plow the land in the fall for oats and to follow the oats with wheat. If the cowpeas are used for hay, it would probably be best to follow with a grain sorghum or corn, then oats and then wheat again. This rotation has been used on similar soils in southwestern Kansas with good results. Since the incorporation of organic matter not only increases the productiveness of the soil but makes it more retentive of moisture, all the barnyard manure and surplus straw available should be plowed under and if sufficient organic matter can not be supplied in this manner, then green-manure crops, such as cowpeas, should be turned under. Land intended for small-grain land should be plowed as early in the season as practicable. Breaking before the 1st of August has proved beneficial on this soil, not only in improving the tilth but also in enabling the soil to absorb and hold the fall and winter rains.

#### KIRKLAND CLAY LOAM.

The Kirkland clay loam to 6 or 8 inches is usually a brown to dark-brown clay loam, though often the surface 2 or 3 inches may be a loam or very fine sandy loam. The subsoil, which extends to a depth of 3 feet or more, is a tough, heavy clay, dark brown in the upper

part and brown to chocolate brown or reddish brown in the lower part. As in the case of the other Kirkland soils the subsoil is a claypan and has many of the characteristics of hardpan, which it is locally called. It rests upon a substratum of unweathered or partly weathered shale. The surface soil contains enough clay to cause it to be somewhat sticky when wet, though it works into good tilth when properly cultivated. In uncultivated fields it bakes hard in dry weather, except for the surface 2 or 3 inches, which usually contain enough sand to have a loose structure.

On the breaks to the stream and where the surface is more sharply undulating, the subsoil has a more pronounced reddish tinge than typical. Along a few of the steeper slopes to drainage ways in the south-central part of the county, the soil has been gullied or the surface clay loam has been eroded away, exposing the claypan and making the land somewhat unsuitable for cultivation. These areas, however, are of such small extent that they do not admit of separation on a map of the scale used.

While the greater part of the material making up this soil is residual from the sandstones and shales of the Permian Red Beds, a few small areas or knolls in the south-central part of the county are included in which the material has probably been derived from both the Red Beds and Tertiary material. Here the surface soil is brown and the subsoil reddish brown. Both contain a small amount of rounded quartz gravel and pebbles.

The only large areas of Kirkland clay loam occur in Mathewson Township. Small areas are scattered over the eastern two-thirds of the county, usually on stream slopes or near stream heads within areas of Kirkland silt loam or loam. They are probably the result of erosion of these soils.

A generally undulating surface results in good drainage over the greater part of this type, but some patches in the larger areas have a rather flat surface and may be wet for a few days after heavy rains. Underdrainage is poor, but ordinarily the rainfall is not sufficient to make the question of drainage a serious one.

Despite the fact that it requires a heavy draft to handle it, this soil, because of its relatively high productiveness, is nearly all under cultivation. The more sloping land and the eroded areas along the streams have been left in the native prairie grasses and are used for pasturage. In its typical occurrence the Kirkland clay loam is known in this county as one of the best upland wheat soils, and most of it is devoted to that crop. Other important crops are oats, kafir, feterita, and corn. Some cotton is grown. On the whole, stock raising is not important, though nearly all farmers raise some hogs and keep a few cattle. In dry seasons the yield of wheat is only 8 to 12 bushels per acre, but in seasons of ample rainfall it may be as



large as 24 to 40 bushels per acre. In normal years the yield of oats is 25 to 35 bushels per acre. The acreage of kafir and feterita is probably more nearly equal on this type than on any other in the county. A yield of 18 to 25 bushels of grain per acre is obtained in normal years, in addition to which there is a good yield of fodder. The uncertainty of corn yields on this soil, partly due to weather conditions, is as great as on any of the other Kirkland soils, if not greater, and many farmers have stopped growing corn on this type, except when the spring is extremely favorable, one of the grain sorghums taking its place. Corn in favorable years gives very good yields, but in exceedingly dry years the returns are very small. Cotton is not grown very extensively on the type, but it gives fairly good yields. Fruits, especially apples, do well if cared for properly.

The Kirkland clay loam is one of the hardest to handle of the more important upland soils. Care must be taken not to cultivate it when too wet, on account of its tendency to clod and bake upon drying. In years of scant rainfall the wheat-stubble land is difficult to plow. In the vicinity of Piedmont many small farmers have abandoned this soil in recent years because of the heavy draft power needed to handle it and the relatively small number of crops that can be profitably grown to utilize the draft power the year around. This movement has resulted in the combining or leasing of several farms by larger operators who use steam and gas tractors and 5 and 6 horse teams in plowing, seeding, and harvesting.

The larger bodies of Kirkland clay loam sell for \$50 to \$80 per acre, depending upon the location, improvements, and the condition of the soil.

Very beneficial results could be obtained on this soil from the addition of organic matter, either by plowing under green manures or by heavy applications of barnyard manure. This would tend to improve the physical condition of the soil, maintain its supply of nitrogen, and increase its power to hold moisture.

#### VERNON VERY FINE SANDY LOAM.

The Vernon very fine sandy loam, to a depth of 6 to 12 inches, is a chocolate-red to reddish chocolate brown, friable very fine sandy loam. This is underlain by a chocolate-red to light chocolate red very fine sandy clay loam to heavy very fine sandy loam which grades at 12 to 24 inches into chocolate-red or light chocolate red fine sandy clay. The lower subsoil is usually more sandy than the upper subsoil. Generally, there is a fairly deep accumulation of weathered material, but in places on slopes the soft, red sandstone bedrock is encountered within 3 feet and in some places it outcrops. On some of the more abrupt slopes and on the more pointed ridges, the soil has a lighter red color than elsewhere. Locally along John Creek

patches of soil occur which have been derived from a coarser grained sandstone than typical, giving rise to Vernon fine sandy loam which is included with the very fine sandy loam because of its small area. In places the subsoil material is quite calcareous. When dry the subsoil is hard, but when moist it is quite friable.

Some areas on the outer edges of the main bodies of the type, such as those to the northwest of Mustang and some detached areas in Yukon, Frisco, and Mathewson Townships and to the north of Calumet, vary from typical in having a light chocolate red clay subsoil extending from 6 to 10 inches to a depth of 3 feet. This clay usually becomes quite friable in the lower part. Other areas, as on the bluffs or breaks to the north of the Canadian River, have patches of soil which is quite loose and incoherent throughout the entire 3-foot section. Here the surface soil is a very fine sandy loam and the subsoil ranges from a clayey very fine sand to a loamy very fine sand.

The Vernon very fine sandy loam is derived from the underlying sandstones and sandy shales of the Permian Red Beds. In general it occupies either the rather smooth divides or the slopes in the higher and more rolling sections of the county. Many smaller, disconnected areas lie in the undulating to very gently rolling regions. In elevation above sea level this soil has a wide variation, ranging from 1,150 feet in the northeastern corner of the county to 1,550 feet near Geary. The largest continuous bodies are found in the vicinity of Mustang to the east and southeast of Okarche, and southeast of Geary. In the southwestern part of the county, especially, the smaller areas occupy slopes or ridges. Many strips of this soil lying along some of the smaller streams in the eastern two-thirds of the county occupy slopes so steep that they can not be cultivated without great likelihood of excessive washing. Such areas have been left in the native timber and prairie grasses. In cultivated fields in the sandier areas the soil drifts rather freely, though not as badly as the lighter Derby soils.

In the larger bodies of this soil erosion has been very active in places, cutting deeply into the underlying strata of sandstone, but the divides and upper slopes are smooth and do not wash badly. Where the slopes are so steep as to be unsuitable for cultivation they are classed as a steep phase. Drainage of the type, even in the smoother areas, is excellent.

The Vernon very fine sandy loam is one of the most extensive upland soils in the county. As a rule it is highly prized for farming, owing to the ease with which it can be handled, its power to retain moisture, and its natural productiveness. Probably over half of it is under cultivation. The remainder, including the more rolling areas, supports a good growth of native grasses and is used for grazing and hay production. The prairie grasses consist chiefly of

mesquite, grama, buffalo, and bunch grasses, with some bluestem in the ungrazed areas. Timber belts lie along most of the drainage ways in the more rolling sections. These furnish shade for grazing stock in the summer time, supply fuel, and protect the slopes from erosion. The trees are chiefly elm, hackberry, black walnut, cottonwood, and oak. Considerable red cedar is said to have stood on this type in the early days, but this tree has now almost disappeared in its native state.

The most important type of farming on this soil is grain growing, combined with the grazing and feeding of beef cattle. Numbers of hogs are raised annually on most farms. The most important crops, are corn, oats, kafir, wheat, and cotton. Fruit, especially peaches and apples, sweet potatoes, melons, and cantaloupes are grown on a small commercial scale in the southeastern corner of the county.

This is one of the most dependable upland corn soils in the county, the yield ordinarily ranging between 15 and 20 bushels per acre and in favorable years running as high as 45 to 50 bushels. Even in exceedingly dry years there is seldom a total failure, if the soil is handled properly. Oats yield 25 to 30 bushels in the average year; wheat, 6 to 10 bushels; kafir, 20 to 30 bushels; and cotton, one-fourth to one-third bale per acre. Alfalfa is quite successful on areas where the underlying rock is not too near the surface. Excellent results have been obtained with Spanish peanuts. The prairie grasses on some areas are cut for hay, the ordinary yield being one-half to two-thirds ton per acre.

With proper care peaches, apples, pears, plums, grapes, and cherries give excellent yields. There are many fine peach and apple orchards in the vicinity of Mustang, and approximately 16,000 bushels of peaches and 6,000 bushels of apples are shipped from this point annually. In the same section watermelons and cantaloupes are grown on a commercial scale, annual shipments amounting to 75 carloads of the former and 10 carloads of the latter. Sweet potatoes are also shipped from the county, though on a small scale. This crop yields 125 to 150 bushels per acre in normal seasons. On many farms there are small vineyards, which give good returns. The Concord is the leading variety.

The Vernon very fine sandy loam is an early soil and one of the easiest in the county to keep in good tilth. Only light draft is required in tillage, and though the soil sometimes tends to form a rather hard crust after rains it yields readily to cultivation and works up into a mellow, friable state. Under proper cultural methods it readily absorbs the rainfall and stores it for the use of the growing crops.

Considerable numbers of cattle are grazed on this type in the western part of the county.

Land of the Vernon very fine sandy loam in the more gently rolling areas sells for \$50 to \$90 an acre depending upon the location, improvements, topography, and condition of the soil. The rougher areas, which are devoted mostly to grazing sell for \$20 to \$60 an acre.

The rotation and agricultural practices suggested for the improvement of the Derby very fine sandy loam apply with equal force to this type.

*Vernon very fine sandy loam, steep phase.*—The steep phase of the Vernon very fine sandy loam includes areas in which the surface is too steeply rolling for tillage. The surface soil consists of 12 to 15 inches of chocolate-red to reddish chocolate brown very fine sandy loam to loamy very fine sand. The subsoil is practically identical with the soil except for its slightly lighter color. It is underlain by a very fine grained red sandstone at a depth of less than 36 inches, as is the typical soil, and outcrops of this rock frequently occur. Some small rolling areas of Derby very fine sand and very fine sandy loam are included in this phase as mapped.

The steep phase of the Vernon very fine sandy loam occurs only in the southwestern part of the county in irregular-shaped bodies on the slopes to the short tributaries of the Canadian River and along Devils Canyon. It has been derived from the same material as the typical soil, from which it differs as the result of more active erosion. The range in elevation from the upper margin of the areas to the beds of the drainage ways varies from 50 to 175 or 200 feet.

Practically all of this phase is used for grazing. Most of it supports a good growth of the native prairie grasses, with considerable blackjack oak timber. It is usually owned in conjunction with surrounding tillable soils.

#### VERNON LOAM.

The surface soil of the Vernon loam is a dark chocolate red to reddish chocolate brown loam, containing relatively large proportions of silt and very fine sand. The subsoil, beginning at 6 or 8 inches, is a chocolate-red clay loam to friable clay extending to 15 inches where it grades into a stiff, light chocolate red clay. This stratum continues without essential change to the underlying Permian rock, which is usually encountered between 30 and 40 inches below the surface. In places the surface soil has a brown or dark-brown color. A 2 or 3 inch surface covering of heavy very fine sandy loam is not uncommon. On the more sloping areas, where erosion has been active, the upper clay loam stratum of the subsoil may be exposed, but such patches are too small to map separately.



The Vernon loam occurs on gentle slopes and narrow, undulating to gently rolling divides. It is developed in only two sections of the county; several small areas lie about 6 miles southwest of Yukon, and scattered areas aggregating several square miles in extent in the vicinity of Piedmont.

The Vernon loam is preferred to the heavier Kirkland soils or to the Vernon clay loam, with which it usually is associated. A large proportion of it is under cultivation. The most important crops are corn, wheat, oats, kafir, and cotton. The grain crops give slightly larger yields in normal seasons than on the Kirkland silt loam. Cotton yields from one-third to one-half bale per acre. Alfalfa, if properly established, does well on parts of the type. The unbroken areas support a good growth of wild pasture and hay grasses.

The Vernon loam is much easier to handle than the clay loam of the series. It holds moisture fairly well and under good farming methods, such as are practiced by the more successful farmers, the crops are able to pass through considerable periods of drought without injury.

Farm land of this type of soil ranges in price from \$50 to \$85 an acre.

#### VERNON CLAY LOAM.

The Vernon clay loam consists of 6 or 8 inches of chocolate-red to dark chocolate red clay loam underlain by a lighter chocolate red clay which extends to a depth of 30 to 36 inches, where the basal substratum of red clay and shale or red shale is encountered. In places the lower subsoil is highly calcareous. A surface veneer of 2 or 3 inches of very fine sandy loam covers some areas.

Along the rather sharp breaks to streams occasional small patches of shaly material appear at the surface. On some of the more gradual slopes or in the vicinity of areas of Vernon very fine sandy loam, small bodies occur where the surface soil is quite sandy and deeper than typical. Here the underlying shaly material lies at greater depths. In the vicinity of darker colored soils, and in some of the narrow areas along the small streams, the soil may have 2 or 3 inches of brownish material on the surface, probably placed there by wind or water erosion. On some of the steeper slopes where erosion is more active and the surface soil has been washed away, small patches of clay may be exposed. Where these are large enough they have been mapped separately. Some coarse material occurs in the upper soil section in a few of the smaller isolated areas.

When dry this soil bakes considerably and is difficult to plow, and if broken when in this state or when too wet it clods badly. Under favorable moisture conditions, however, it is quite friable and works into good tilth. In any case heavy draft power and heavy implements are required.



Most of the Vernon clay loam occurs as irregular, narrow strips along the small streams from Heaston eastward for a distance of 18 or 20 miles, in rather small, disconnected bodies in the "gypsum hills" section to the northwest of Concho, and in large continuous bodies or strips in the northeastern part of the county. Small isolated areas occur over the eastern two-thirds of the county. The larger areas occupy gradually sloping well-drained positions in regions of undulating topography, but in the smaller areas the surface may be more abruptly sloping, and here the type is subject to rather severe erosion. A few of the smaller areas occupy minor elevations in the upland.

This is one of the best upland wheat soils in the county and much of it is under cultivation. The uncultivated areas support a good growth of prairie grass and are used for grazing. The crops grown and their yields are practically the same as on the Kirkland clay loam. Though a minor crop, cotton is grown more extensively than on the Kirkland soil and the yield is good if the crop is handled properly. Considerable success has been had with alfalfa on parts of the type.

The Vernon clay loam is farmed in much the same way as the Kirkland clay loam, with which it is often associated in the same farm. In selling value it ranks as high as or even slightly higher than the latter type.

The incorporation of organic matter in the soil to improve the physical condition and increase the water-holding capacity and the planting of the more abruptly sloping areas to crops that tend to prevent washing will be found beneficial.

*Vernon clay loam, eroded phase.*—The eroded phase of the Vernon clay loam comprises areas on the stream slopes that have been too severely eroded or gullied to allow their satisfactory use for cultivated crops. The surface soil is usually shallow and in many places small clay patches are exposed. This soil occurs in the eastern two-thirds of the county in very narrow strips scattered along some of the smaller drainage ways. The areas usually include ravines with rather steep slopes. Very little of this land is now under cultivation. It is used chiefly for grazing.

#### VERNON CLAY.

The Vernon clay is a chocolate-red clay, underlain at about 6 inches by a rather stiff, light chocolate red clay, which continues to a depth of 30 or 36 inches. There are usually some small lime concretions below 20 inches. The material immediately below the subsoil consists of unweathered red shale of the Permian Red Beds and is rather tough and impervious. This material may come closer to the surface

on the washed-out or sloping portions of the type. In some of the flatter areas the surface soil may approach the Kirkland soils in color characteristics, being darker than typical.

Only two small areas of Vernon clay occur in Canadian County, one near the northeast corner of the county and the other in sec. 17, T. 14 N., R 8 W. The surface is flat to very gently undulating and drainage, though fairly well established, is slow.

Probably half of this soil is under cultivation, the remainder supporting a fairly good growth of prairie grasses. The type is devoted chiefly to wheat, oats, and the grain sorghums, the yields being somewhat smaller than on the Vernon or Kirkland clay loams. The soil is heavy and intractable, requiring strong implements and powerful draft for its proper cultivation. It usually pulverizes easily when plowed under the proper moisture conditions, but if plowed when too wet it is likely to clod and bake upon drying.

Most of the Vernon clay is held at somewhat lower prices than the Vernon or Kirkland clay loam soils, but the best areas bring about the same price as the clay loam types.

This soil would be benefited considerably by the addition of barnyard manure and other organic matter and by the growing and plowing under of cowpeas or other green-manure crops.

*Vernon clay, eroded phase.*—The Vernon clay, eroded phase, consists of a red to chocolate-red, stiff clay ranging in depth from a few inches to 3 feet or more, underlain by unweathered red shale. Usually fragments of the parent rock and small quantities of concretionary gravel, and in the "gypsum hills" section small fragments of impure gypsum, are scattered over the surface.

Small disconnected areas and long irregular strips of this phase occur around the heads or along the courses of the small drainage ways in the northeast corner of the county, in the south-central part and in the gypsum hills section. Many small areas, too small to map, are included with the Vernon clay loam and its eroded phase, which are usually the surrounding soils.

The Vernon clay, eroded phase, consists of raw, freshly exposed clay, and is of low agricultural value. The areas include exposed sections of clay and patches of barren clay and shale representing the floor to which deep erosion proceeded until checked. Occasionally small mounds of clay and shale occur on the deeply eroded flats where the material was resistant to the erosional forces. These mounds may contain a small admixture of wind-blown soil. Some narrow areas lie along the smaller drainage ways, which are merely ravines.

Practically none of this phase is under cultivation except smooth areas 1 or 2 acres in extent lying adjacent to cultivated fields on some

other type. In its native state much of the phase is quite bare of vegetation, except where it has been eroded and weathered the longest or where material from other soils has been washed over the surface. Here there is a sparse growth of prairie grasses. The only practical use made of this soil is for grazing stock. It is usually included in farms with other soils, and where much of it is included it decreases the selling value of the farms considerably.

#### DERBY FINE SAND.

The Derby fine sand consists of light-brown or brownish-gray fine sand passing at 5 or 6 inches into a pale-yellowish or pale-brownish fine sand, which continues to the depth of 36 inches or more. The lower portion of the 3-foot section frequently contains some coarse sand and may have a reddish color.

There are included some small areas of Derby very fine sand, occurring on long gentle slopes bordering some of the small drainage ways in the southwestern corner of the county. This soil appears to hold moisture better and to be less subject to blowing than the fine sand.

The Derby fine sand occurs on small ridges or hummocks in the large area of Derby fine sandy loam north of the North Fork. One area lies about 3 miles west of Heaston. The surface is undulating to billowy and dunelike and the soil drifts considerably where not covered with a good growth of timber. The drainage is thorough.

This is not an important agricultural soil. Most of it remains in the native growth of blackjack oak and underbrush, with a scant growth of grass. The cultivated land is devoted to the production of garden crops for home use and to the growing of kafir. The soil is usually included in pasture with the surrounding Derby fine sandy loam.

The included areas of Derby very fine sand are highly prized for growing cotton and vegetables and fruit for home consumption. They produce fairly well even in dry years. Cotton yields one-fourth to one-half bale per acre; corn 12 to 18 bushels, and kafir 15 to 20 bushels. Peaches, grapes, cantaloupes, melons, and peanuts do well. About one-fifth of the area is cultivated, the remainder supporting a growth of blackjack oak and some grass. The land is valued at \$20 to \$50 an acre.

#### DERBY FINE SANDY LOAM.

The surface soil of the Derby fine sandy loam ranges from brown fine sand or loamy fine sand to a brown or reddish-brown fine sandy loam. The subsoil, beginning at about 10 to 12 inches, is a light brown to yellowish-brown or reddish-brown fine sandy loam, which

passes into a more compact, yet friable, fine sandy clay of yellowish-brown or reddish-brown color. Considerable coarse sand may occur throughout the 3-foot section, especially on the north slopes to the North Fork of the Canadian River and in smaller isolated areas, and the subsoil in such places becomes loose and friable in the lower depths.

The areas of this type having the heavier surface soil occur mainly from Concho east; the immediate slopes to the alluvial land in this section of the county usually have sufficient coarse sand in the surface soil to class it as a sandy loam. In the more nearly level areas in the northwestern part of the county the surface soil frequently attains a depth of 20 to 24 inches. Here it is a uniform brownish fine sand, except for the surface 6 inches which in areas more recently brought under cultivation may be slightly darker than typical, owing to the larger amount of organic matter present. The brownish sandy clay subsoil in places has a reddish tinge in the lower depths. In general, the surface soil in this section of the county is deeper and lighter colored on the ridges or mounds and shallower and darker colored in the intervening lower lying slopes and swales.

The Derby fine sandy loam occurs chiefly in a continuous strip of irregular outline bordering the bottom land of the North Fork of the Canadian River on the north. This strip varies in width from 1 to 3 miles. A few areas of this soil occur north of the Canadian River in Maple Township. Except for the areas northwest of Concho, it occupies gently rolling situations on the slopes to streams. From Concho northwest it occupies the gentle slopes leading down to the North Fork bottoms, the divides, and many of the gradual slopes to the tributaries of the Cimmaron River. The surface on the divides is gently undulating to billowy, and owing to the rather open nature of the soil and subsoil the drainage is good.

This is the only important upland soil that is well timbered. Most of the uncultivated area northwest of Concho is covered with black-jack oak and underbrush. The forest land and the remainder of the uncultivated areas support a rather sparse growth of grass and are used for pasture.

The Derby fine sandy loam is an important agricultural soil, and probably 40 per cent of it is now under cultivation. It is productive and is said to resist drought remarkably well. The loose nature of the soil makes it easy to handle with the lightest implements and traction power. The more important crops are corn, oats, kafir, feterita, milo, and cotton. Some wheat also is grown. Hog raising and cattle raising are the most important live-stock industries, and some dairy cattle are kept in the vicinity of the towns.

The production of fruit is of some importance in the sections around Yukon and to the northwest of Calumet. Good results have

been obtained with peaches, apples, plums, and grapes. The leading variety of peach is the Elberta; of apples the Winesap, Jonathan, and Ben Davis; and of grapes the Concord. Many other varieties of each of these fruits are grown. While little fruit is shipped from the county, considerable is sold in the towns and to the farmers on heavier soils. Watermelons, cantaloupes, Irish potatoes, and sweet potatoes produce good yields under a wide range of moisture conditions. Peanuts do well.

Corn yields an average of 12 to 18 bushels per acre. Even in dry seasons, if cultivated properly, grain sorghums yield 15 to 25 bushels of grain per acre, in addition to considerable forage. The soil is too light for profitable wheat production, which is shown by the low average yield. Oats yield 20 to 25 bushels per acre in normal seasons. Considering the latitude cotton does well, yielding from one-third to one-half bale per acre, and this is probably the most popular cotton soil in the county. Sweet potatoes yield 75 to 175 bushels per acre.

Land of this type varies considerably in price, depending upon the improvements, the location, and the character of the native vegetation on uncultivated areas. Prices range from \$20 an acre for the rougher and poorer areas to \$60 or \$80 an acre for the average well-improved farm. Some of this land in the vicinity of the towns has recently sold at an even higher price.

As this soil is deficient in organic matter in most fields that have been cultivated, the heavy application of barnyard manure or the plowing under of green-manure crops would be of great benefit. Such treatment will not only increase the productiveness through fertilization, but will also improve the physical conditions by making the soil more coherent, one result of which will be to reduce drifting.

#### DERBY VERY FINE SANDY LOAM.

The Derby very fine sandy loam consists of a brown to reddish-brown very fine sandy loam to loamy very fine sand, underlain at 6 to 10 inches by a light-brown, brown, or reddish-brown sandy clay loam. This passes at 12 to 16 inches into a compact, yet friable, fine sandy clay or fine sandy clay loam of a brown to reddish-brown color. The areas of lighter textured surface soil occur south of the Canadian River and in the adjacent uplands to the north of that stream, while the heavier surface soil is encountered in areas farther away from the river.

The brownish-red soil found in places is developed where the surface covering of wind-blown material is rather thin and the underlying red Permian sandstone lies nearer the surface. The boundary lines between this soil and the Vernon very fine sandy loam, with which it is closely associated, can not everywhere be closely drawn, owing to the gradual transition in texture and color.



In places, as on the lower slopes and rather flat divides, the surface soil may be deeper than typical and the subsoil color of a lighter brown to yellowish brown. On slopes adjacent to the Derby very fine sand the surface soil may attain a depth of 15 to 24 inches. Relatively larger proportions of fine sand occur in the material throughout the 3-foot section in some of the areas north of the Canadian River. The lower subsoil is rather tough in places, especially in the areas farthest from the larger streams.

The Derby very fine sandy loam is derived largely, and in many cases entirely, from wind-blown material. The largest areas lie near the Canadian River, in the western half of the county. Considerable areas are mapped in the north-central and east-central parts. The type usually occupies slopes and rather narrow divides. Its topography is more or less rolling, but rarely so strongly rolling as to interfere with safe cultivation. The type has excellent surface drainage and underdrainage.

This is one of the most desirable upland soils in the county. It holds moisture remarkably well and is very productive. Probably 70 per cent of the type south of the Canadian River is under cultivation and approximately 50 per cent of the remainder. The untilled areas support a good growth of prairie grass and are used for pasturage and hay production. Some large pastures are maintained on this soil.

The most important crops are corn, oats, grain sorghums, cotton, and wheat. The principal live-stock industries are hog raising and cattle raising, with some dairying carried on in a small way near the towns. The beef cattle are usually summer pastured on this type, or, as in the southwestern part of the county, on near-by rough soils, and are fed and fattened during the winter on pasture, with supplementary feeds. While there are a few large herds of hogs, most of the farmers keep only a few head and fatten a small number each winter for marketing. Some sheep are raised in the more rolling sections.

All the common fruit trees do well on this soil and the majority of the farms have small orchards to supply fruit for home use. Peaches, apples, and grapes do exceptionally well, and a few farms in the eastern part of the county grow these fruits on a small commercial scale. Watermelons, cantaloupes, Irish potatoes, and sweet potatoes do as well as on the Vernon very fine sandy loam. Potatoes yield as much as 100 bushels or more per acre and sweet potatoes as much as 150 to 175 bushels. Peanuts are not generally grown for stock-feeding purposes, although they do remarkably well. Small patches of sorghum are grown on many farms for the production of sirup for home use. The yields are good. Sudan grass affords two or

three cuttings and yields about 3 tons of forage per acre per season. Corn yields 16 to 20 bushels per acre in normal seasons and 40 to 60 bushels in very favorable years. Ordinarily oats yield 20 to 25 bushels per acre, wheat 6 to 10 bushels, and kafir and milo 15 to 25 bushels. Ordinarily the yield of cotton is between one-third and one-half bale per acre. Alfalfa where it has been tried promises well. While yields vary considerably with the rainfall, a complete failure of the common crops seldom, if ever, occurs.

The Derby very fine sandy loam is one of the easiest types in the county to handle. The surface soil is loose and a good seed bed can be prepared with light teams and implements. An efficient mulch can be maintained with a minimum of cultivation. On the best farms barnyard manure is plowed under to improve the soil. Drifting of the surface soil in the lighter textured areas is held in control by keeping the surface in a roughened or ridgy condition as much as possible.

Land of the Derby very fine sandy loam is valued at \$30 to \$90 an acre, depending upon the distance from market, the improvements, and the topography.

This soil in places has been farmed for long periods without the rotation of crops or the turning under of a green-manure crop, and the supply of organic matter has been reduced, resulting in decreased yields even in years of favorable moisture conditions. In such cases it would be advisable to practice a system of crop rotation, including a green-manure crop, preferably a legume. A rotation suggested by the Extension Division of the State Agricultural Experiment Station includes corn, oats, and cowpeas or peanuts, or both of the latter; the cowpeas to be planted in the corn or grown in a separate year and the peanuts planted the year following corn. Good results have been had with this rotation on similar soils in southwestern Kansas. The more extensive production of sweet potatoes and Irish potatoes for home use and local sale would apparently be profitable, owing to the good yield of these crops and the lack of sufficient quantities in the average year to supply the home demand. In places subject to washing the growing of Bermuda grass will not only tend to check erosion by forming a good sod but will give excellent pasturage.

*Derby very fine sandy loam, steep phase.*—The steep phase of the Derby very fine sandy loam includes those areas which are too steeply rolling to permit of the usual farming practices. The surface soil differs from the typical in being much deeper, especially on the lower slopes. The subsoil is usually a brown to light-brown, friable sandy clay. Small outcrops of red sandstone are not uncommon on the steeper slopes, giving rise to a reddish soil immediately below them.

This phase is not very extensive. The largest bodies occur in the rolling region near Kickapoo Canyon, in one or two small areas along Boggy Creek, and north of the Canadian River in section 9, township 12 N., range 10 W. The latter area resembles Rough broken land, containing numerous exposures of brown sandy clay and having a few sandstone rocks on the surface. Most of the phase supports a growth of blackjack oak, with, in places, a sparse growth of prairie grass. The greater part of this land is utilized for pasture, which probably is its best use. It sells for \$6 to \$15 an acre.

#### DERBY LOAM.

The Derby loam consists of 8 to 10 inches of brown to reddish-brown loam, underlain by a brown to reddish-brown sandy clay loam which grades at about 20 inches into a brown to reddish-brown sandy clay. The lower subsoil in places has a rather tough structure. In all places the content of very fine sand in the surface soil is relatively large, but the soil as it turns from the plow is a good loam. The subsoil is generally not as friable as that of the very fine sandy loam type. Many patches of the latter type are included with the loam on account of their small size. Near areas of the Derby fine sandy loam the type contains considerable fine sand throughout the entire 3-foot section, as the two soils grade into each other.

The Derby loam occurs in the upland on both sides of the North Fork, from Fort Reno east, and to the north of the Canadian River from Heaston east to within a few miles of Mustang. The larger areas are in the vicinity of Yukon. The type has a gently sloping to gently rolling surface and is well drained.

This is one of the best upland soils, and over half of it is under cultivation. The uncultivated areas support a good growth of grass and are used for pasture. The principal crops are corn, wheat, oats, kafir, and cotton, with some alfalfa. Hog raising is an important live-stock industry, especially in the areas south of the North Fork. Here also considerable dairying is carried on the year round, the cattle being pastured in the summer months, with occasionally some supplementary concentrates and fed in the winter on corn and kafir fodder, alfalfa or prairie hay with additional grain feeds. The milk or cream is either sold in the near-by towns or shipped to the city of Oklahoma. Some fine Holstein and Jersey herds are kept in these dairies.

Crop yields are about the same as on the Derby very fine sandy loam, with possibly a higher average yield in the case of wheat. Alfalfa, while not grown extensively, does well where the underlying sandstone is not too close to the surface. Bermuda grass and Sudan grass do well. Practically all the grain and hay crops are fed to stock on the farm.

The soil is easy to cultivate, because of the relatively high percentage of very fine sand, and a good tilth can be maintained with light implements and teams. The topography is favorable to the use of all kinds of improved farm machinery. The soil is little subject to drifting.

Land of the Derby loam sells for \$50 to \$90 an acre, depending upon the location, improvements, and conditions of the soil.

The general methods of soil improvement suggested for the Derby very fine sandy loam should prove equally beneficial on this type. Already considerable barnyard manure is used with good results.

#### CANADIAN VERY FINE SAND.

The Canadian very fine sand consists of light-brown to brown very fine sand, grading at about 8 inches into light-brown very fine sand which becomes yellowish in the lower part of the 3-foot section. The soil is loose and where bare of grass or low in humus it drifts to some extent. A few included areas in the eastern part of the county have a loamy surface soil.

The type occurs in areas lying well above overflow in the second bottoms of the Canadian River and its North Fork. The surface is gently undulating to very nearly level, marked in places by small sand dunes. In many areas drainage is so thorough that crops suffer severely from drought.

The greater part of the type is under cultivation. When it is handled under proper farming methods it holds moisture remarkably well, considering its open nature, and produces good yields. The uncultivated portions of the type are mainly narrow strips next to the overflow land. They support a fair growth of prairie grasses, with occasional clumps of wild plum, and are used as pasture land.

This soil is well adapted to corn, the grain sorghums, and cotton, and is usually devoted to these crops. It is too light in texture for the best production of small grains, yet after it is built up through the addition of organic matter, as it has been on a few farms in the eastern part of the county, good yields of the small grains are obtained. Sorghum, peanuts, beans, and truck crops all do well and are grown on a small scale. Peaches also do well.

Corn is said to yield as much as 50 to 60 bushels per acre in favorable years, and from 5 to 10 bushels in the driest years. Cotton averages about one-third bale per acre, even in dry years. Kafir yields 15 to 25 bushels of grain in the average year. Higher yields are obtained on the more loamy areas in the eastern part of the county. There are some good fields of alfalfa in this section.

The more successful farmers, who grow the greatest variety of crops with the highest average yields, apply an abundance of barnyard manure and other coarse organic matter to the soil and occa-

sionally plow under a green-manure crop. This tends not only to increase the yields through fertilization, but also to put the soil in better physical condition, enabling it to store more moisture and to resist drifting. The better farmers advocate deep plowing. Only light draft power and light implements are needed in ordinary farm operations.

Land of this type usually is held at \$50 to \$65 an acre, but a few farms in the eastern part of the county have recently sold at a much higher price.

On account of their limited extent some small areas of Canadian fine sand are included with the very fine sand. This soil differs from the very fine sand chiefly in its coarser texture, looser structure, and consequent greater susceptibility to drifting. It consists of 6 inches of light-brown fine sand, overlying light-brown to yellowish fine sand. This soil occurs on low terraces in the south-central part of the county. Along the Canadian River it lies 5 to 10 feet above the first-bottom land. Part of it has a nearly level surface; the remainder is hummocky and very much subject to wind erosion. Drainage is good. About half of this soil is under cultivation. The uncultivated land, which usually includes the hummocky areas, supports a sparse growth of grass and occasional clumps of bushes and is used for pasture. Most of the cultivated area is devoted to corn, which yields 10 to 25 bushels per acre in normal seasons and as much as 50 to 60 bushels on the more loamy areas in seasons of ample rainfall. Some cotton and kafir are also grown. Cotton yields one-fourth to one-third bale per acre. The Canadian fine sand is adapted to vegetables, watermelons, cantaloupes, sweet potatoes, and berries. Peaches should do well. Peanuts produce good yields. The blowing of the hummocky areas can be checked considerably by the incorporation of organic matter.

#### CANADIAN VERY FINE SANDY LOAM.

The Canadian very fine sandy loam consists of a brown to grayish-brown, loamy very fine sand to very fine sandy loam or a light-brown very fine sand, passing at 10 to 15 inches into a light-brown to yellowish-brown friable, very fine sandy loam. The lower subsoil in many places is a pale yellowish, loamy very fine sand. In places on the breaks between the second and third bottoms in the northwestern part of the county the subsoil in narrow areas is reddish-brown. In the vicinity of areas of the Canadian very fine sand, with which this type is closely associated, the surface soil may extend to depths ranging from 15 to 20 inches. Adjacent to bodies of the heavier Canadian soil the subsoil becomes much heavier in places than typical, even approaching a clay loam.



The Canadian very fine sandy loam occurs on distinct second bottoms, lying above overflow, along the rivers and some of the smaller streams. It is most extensive along the North Fork of the Canadian River. It generally lies 15 to 20 feet above the streams, but part of it lies on the inner margin of a third bottom south of the North Fork in the western part of the county. Here it is situated 25 to 40 feet above the streams. The surface is almost flat, but there is a very gradual slope towards the first bottom and drainage is well established.

This, the most extensive terrace soil in the county, is very important agriculturally, approximately three-fourths of it being under cultivation. The uncultivated land remains in the native grasses and is used for pasture. While the soil is somewhat inclined to drift, the tendency is not as marked as in case of the Canadian very fine sand and fine sand. The surface soil is rather loose and a good tilth is easily maintained. The type is said to hold moisture well and it is very productive. All the crops grown in this region do well. The most important are corn, oats, wheat, grain sorghums, and alfalfa. Hog raising is the leading live-stock industry. The hogs are often summer pastured on alfalfa and are fattened on corn with supplementary concentrates. Dairying is engaged in on a small scale in connection with general farming. A few pure-bred herds are kept by farmers in the vicinity of El Reno and Yukon. Raising and fattening beef cattle is another important industry, pasturage being obtained on this or adjacent sandier types. Feeders are shipped in by the carload from the markets in the city of Oklahoma and fattened during the winter months. Corn is the main grain feed and prairie hay, alfalfa, corn, and kafir fodder or ensilage form most of the forage. There are on this type several silos which are filled mainly with corn and kafir. Fruit trees do well if properly cared for, especially peaches and apples. No large commercial orchards are maintained, but most of the farms have home orchards.

Corn yields on this soil, while subject to variation with the rainfall distribution, are usually among the best in the county, averaging 15 to 25 bushels per acre in ordinary years. Oats ordinarily yield 20 to 25 bushels per acre, wheat 10 to 15 bushels, kafir 14 to 24 bushels, and alfalfa 2 to 3 tons. Much higher yields of the grain crops are obtained in years of ample and well-distributed rainfall. Alfalfa fields are not as durable as on the heavier Canadian soils. Cotton yields one-fourth to one-third bale per acre, but the crop is subject to damage by the cotton-boll worm, and this has tended to decrease the area planted. Sudan grass affords two or three cuttings annually, with a total yield of about 3 tons per acre. Sweet potatoes yield 75 to 150 bushels per acre. Peanuts and cowpeas give good yields.

Land of the Canadian very fine sandy loam sells for \$50 to \$100 an acre, depending on the location and character of the improvements. This is one of the most desirable bottom-land soils for farmsteads and often it is chosen for that purpose in the sections where the heavier soils predominate.

Most of this type is rather deficient in organic matter, as is indicated by the light color, and the supply should be increased by applying barnyard manure and plowing under green-manure crops. The adoption of properly balanced crop rotations will also be beneficial. A rotation suggested by the Extension Department of the State Agricultural Experiment Station includes corn, oats, wheat, and alfalfa, with cowpeas as green-manure crop. Grain sorghums may be introduced into the rotation in years unfavorable for corn.

*Canadian very fine sandy loam, colluvial phase.*—The colluvial phase of the Canadian very fine sandy loam consists of a brown, loamy very fine sand to very fine sandy loam, overlying at 10 to 15 inches a yellowish-brown to reddish-yellow fine sandy clay to fine sandy loam, which usually becomes quite friable and loose in the lower part. In places the soil adjacent to the Derby fine sandy loam contains a relatively large proportion of fine to medium sand and the material may be light textured and loose structured throughout the 3-foot section. In areas adjacent to the Vernon soils or to outcrops of red sandstone the soil and subsoil are in places chocolate red in color. These variations, while quite numerous in the areas north of North Fork, are usually small in extent.

This phase is most extensive to the north of the North Fork at the outer edge of the terraces. Two areas are mapped south of Heaston along the Canadian River bottoms. The areas are long and narrow and rise toward the uplands, from which a part of the soil material has come as colluvial wash. Drainage is well developed.

This is a desirable soil for farming. It is handled in much the same way as the typical soil, the same crops are grown, and approximately the same yields of most crops are obtained. Wheat is the exception, the yield being smaller, as a rule, on account of the looser and more open nature of the soil. Alfalfa occupies a relatively smaller acreage. Considerable fruit is grown for home use. One farm close to Smithton is devoted almost entirely to peach and apple growing.

There are many well-improved farmsteads on this phase, especially in the vicinity of Smithton and the Frisco School.

#### CANADIAN LOAM.

The Canadian loam is a brown to dark-brown, mellow loam, underlain at 8 to 10 inches by a light-brown, friable heavy loam to light silty clay loam, which grades at about 20 inches into a yellowish-

brown or slightly reddish brown friable loam to light silty clay loam. The surface soil usually contains a relatively large proportion of very fine sand. The subsoil is highly calcareous. In places near areas of Canadian clay the lower subsoil is a light clay loam, while near the Canadian very fine sandy loam it may be very light textured, in places a loamy very fine sand.

The Canadian loam lies on the second bottoms along both the Canadian River and the North Fork, but it reaches its greatest development along the North Fork. It lies 15 to 20 feet above the stream. The surface is quite uniformly flat or only very gently undulating, but drainage is good.

This type is regarded as one of the best of the alluvial soils. It is productive and easy to handle. With the exception of a few small pastures, it is all under cultivation, devoted largely to corn, alfalfa, wheat, and oats. Hog raising is the principal live-stock industry. Alfalfa is grown for summer pasturage and the hogs are fattened with corn and concentrates. Considerable dairying is carried on near the towns and along the railroads east of El Reno, and a few pure-bred herds are kept. Some beef cattle are raised, usually being pastured on near-by first-bottom soils.

Corn yields as much as 50 or 60 bushels per acre in favorable years and 10 to 20 bushels in the drier years. Next to the Canadian clay this is regarded as the best terrace soil for alfalfa and it produces nearly as good yields as the former type. Wheat yields 12 to 20 bushels per acre in normal seasons, and oats 25 to 40 bushels. Kafir gives good yields. Cotton yields one-fourth to one-third bale per acre, but is not grown as extensively as in years past.

This soil is handled in much the same way as the Canadian clay with which it is often associated, but it does not require as heavy tillage implements or draft power. The price of the land is about the same as that of the clay.

The crop rotation suggested for the Canadian very fine sandy loam should prove equally successful on this type. Care will be necessary to maintain the type in its present state of productiveness.

As mapped, some areas of the Canadian silt loam of small extent are included with the loam. The soil in these consists of 6 to 8 inches of brown to dark-brown mellow silt loam. The subsoil is brown to light-brown or in places chocolate-brown, friable clay loam to clay, passing at 20 to 24 inches into a yellowish-brown to chocolate-brown rather compact clay. The surface soil is usually high in organic matter. The subsoil is calcareous and may be much darker than typical near areas of Canadian clay. The small area in section 17, Darlington Township, differs from the description just given in that the upper subsoil is a very dark gray to black clay and the lower sub-

soil a chocolate-red clay. The Canadian silt loam lies along the North Fork in the eastern two-thirds of the county. It is best developed in the vicinity of Yukon. In general the surface is flat to nearly level, though there is enough slope to give good drainage.

Practically all of the silt loam area is under cultivation. It is very productive and highly valued for corn and alfalfa, to which it is largely devoted. The same crops are grown as on the Canadian loam and practically the same yields are obtained. The raising and feeding of hogs and cattle are the most important live-stock industries. Dairying is carried on in a small way. This soil is handled in the same way as the Canadian loam. It is easily tilled and does not clod nor bake badly. Barnyard manure is occasionally applied on the best farms, to which treatment the soil responds readily. The land sells for \$75 to \$125 an acre. The methods of soil improvement successful on the Canadian loam can be applied with good results to the silt loam.

#### CANADIAN CLAY.

The Canadian clay consists of a dark-brown clay, about 6 inches deep, underlain by a clay of darker brown color, changing to chocolate brown or dark yellowish brown in the lower part of the 3-foot section. The subsoil is rather tough when dry and contains numerous small lime concretions in the lower part. The surface soil is also calcareous in places. A stratum of brownish-colored sand containing more or less adhering clay usually underlies the soil at depths ranging from 3 to 5 feet. In the areas north and east of El Reno the upper part of this substratum in places contains a small amount of alkali salts.

On the outer border of areas of this type, the surface 2 or 3 inches may consist of a dark-brown loam, silt loam, or silty clay loam. This is especially true in the areas included in the United States Military Reserve and in those east of El Reno. In parts of the type lying in secs. 17 and 20, T. 13 N., R. 8 W. the upper subsoil in places consists of a nearly black, rather stiff clay, and the lower subsoil is a dark chocolate red clay.

The Canadian clay occurs on a terrace lying 15 to 20 feet above the North Fork. The largest areas, which cover from 1 to 3 square miles, occur east of Calumet, in the vicinity of El Reno, and north and east of Yukon. Smaller bodies lie on both sides of the river from Calumet east, and on the north side of the river from Calumet west. These areas are situated in the middle of the rather broad terrace or back towards the adjoining upland. The surface is flat to level. Surface drainage is naturally rather slow, but in most places has been improved by ditching. Underdrainage is fairly good, owing to the substratum of sand.

The Canadian clay is important agriculturally, as it is one of the most productive alfalfa soils in the county. Probably 80 per cent of it is under cultivation. The remainder, which usually includes the more poorly drained areas, makes fine pasture land. Most of the cultivated land is devoted to alfalfa. Other important crops are corn, wheat, and kafir. Some hogs are pastured on alfalfa, but most of the crop is cut for hay. Alfalfa yields 3 to 5 cuttings a year, with an average total yield of 3 to 4 tons per acre. Much of the hay is used locally in fattening cattle and feeding work and dairy stock, but a considerable quantity is shipped to eastern Oklahoma, Texas, and other markets. Some of the alfalfa fields have been producing profitable yields for over 10 years without reseeding. Corn yields are good. Wheat also yields well, but in the wetter seasons is somewhat inclined to produce straw at the expense of grain. Kafir, when closely drilled, gives large yields of coarse forage.

While this soil is not especially intractable, heavy machinery and draft power are needed to handle it properly. Care must be taken not to work it under unfavorable moisture conditions, as it clods when plowed wet and bakes upon drying. The soil cracks considerably in dry seasons.

Alfalfa is usually sown in the fall, but good results have followed spring seeding when moisture conditions have been favorable. The hay is usually baled, either as soon as it is cured in the windrow or from the stack later in the season. The latest improved machinery is used in harvesting operations. Most of the kafir is drilled and cut as a forage crop. Very little manure is applied to the soil.

Areas of the Canadian clay occupied by a good stand of alfalfa sell for as much as \$100 to \$125 an acre. Other areas are held at \$65 to \$100 an acre, depending chiefly upon the state of cultivation and the drainage conditions.

The uncultivated areas of this soil would be greatly benefited by ditching to hasten the removal of the surface water in wet seasons. Too little attention has been paid to maintaining the organic content of this soil; while it is naturally high in this constituent, continued cropping will eventually lessen the supply and cause a decline in productiveness. The application of barnyard manure or the plowing under of green manure should be made a part of the management. When the alfalfa stands thin out, the adoption of a rotation including wheat, corn, and possibly oats along with that crop would prove beneficial.

*Canadian clay, poorly drained phase.*—The poorly drained phase of the Canadian clay is a black clay, underlain at about 6 inches by a very dark brown to dark-drab clay which may become dark chocolate brown in the lower part of the 3-foot section. Both soil and subsoil are calcareous, and the latter frequently contains whitish spots of



"alkali" salts. In a few patches there is a thin whitish incrustation on the surface in dry seasons.

This phase occurs in slight depressions or in level situations where the drainage is not so good as in the areas of the typical soil. It is mainly confined to the north terrace of the North Fork of the Canadian River northwest of Calumet.

The greater part of the phase supports a growth of salt and prairie grasses and is used for pasturage. Where cultivated it is usually devoted to kafir, which gives good yields of forage. The land sells at somewhat lower prices than the uncultivated areas of typical Canadian clay.

The phase would be greatly benefited by the installation of drainage systems. With the removal of the excess water, the greater part of the injurious salts would be carried away. These appear to have accumulated in the soil through the evaporation of seepage waters.

#### CALUMET VERY FINE SANDY LOAM.

The surface soil of the Calumet very fine sandy loam is a brown to dark-brown or dark grayish brown, heavy very fine sandy loam, 8 to 10 inches deep. The subsoil, to 15 or 18 inches, is a brown, heavy very fine sandy loam to loam, below which it is a brown to chocolate-brown tough clay or claypan. The surface soil is friable and in places approaches a loam in texture, though the very fine sand content is always high. In some patches the upper subsoil is a silty clay loam or clay loam and on some of the stream slopes the surface soil directly overlies the brown to reddish-brown claypan. Small lime concretions frequently occur in the lower subsoil.

The Calumet very fine sandy loam lies on the south terrace of the North Fork of the Canadian River from El Reno west to the county line. Most of it lies in one continuous strip, 1 to 3 miles wide, sloping gradually from the adjacent upland toward the lower terraces. The general appearance is that of a very old terrace, with a smooth surface cut only by the valleys of intermittent streams issuing from the adjacent hills. The terrace surface is 50 feet above the river, and from 20 to 30 feet above the next lower terrace. Its surface is sloping or undulating enough to give adequate run-off, but underdrainage is slow on account of the claypan forming the lower subsoil and substratum.

This soil and the related Calumet silt loam occupy almost all the higher terrace. As the lower terrace is approached the surface material becomes sandier and the subsoil more friable and the type grades into the Canadian very fine sandy loam, which occupies the lower terrace. The Calumet soils are the terrace equivalents of the upland Kirkland soils.

The Calumet very fine sandy loam is productive, easily tilled, and as a rule not subject to drifting. It is highly prized as a wheat soil, and with the exception of a little pasture land on each farm it is all under cultivation. The most important crops are wheat, oats, kafir, and corn. Alfalfa does well in places, but it is not generally grown. Some cotton is planted. Sudan grass gives good yields. The principal live-stock industries are hog raising and beef production, with some dairying on a small scale. There are a few herds of pure-bred cattle in the vicinity of Geary. The most popular breed is the Shorthorn. There are a large number of silos on this soil. The pastures support a good native sod, chiefly of mesquite grass, grama grass, and buffalo grass, with considerable bluestem in areas that have not been grazed long.

Yields of 25 to 30 bushels of wheat per acre are not uncommon in favorable years; in the less favorable years yields of 8 to 15 bushels are obtained. In normal seasons oats yield 20 to 30 bushels per acre, and kafir and milo 18 to 25 bushels. The latter crops give considerable fodder in addition to the grain. Corn yields vary widely with the moisture conditions. High yields are obtained in favorable years, but very low yields in exceedingly dry years. The yield of cotton ranges from one-fourth to one-third bale per acre, but this crop has not been very extensively grown in recent years. Sudan grass yields 2 to 3 tons of hay per acre annually. Alfalfa yields 2 to 4 tons for the first few years, but over much of the type this crop is injured considerably in dry years. However, it is said to do better than on the Kirkland soils. Peanuts should be a successful crop. The soil is handled in much the same way as the Kirkland silt loam and the same farm practices should be beneficial.

Farms of the Calumet very fine sandy loam are held at \$50 to \$90 an acre, depending upon the location with regard to markets, the character of the improvements, and the condition of the soil.

#### CALUMET SILT LOAM.

The Calumet silt loam is a brown to dark-brown silt loam, 6 to 8 inches deep, underlain by a brown silty clay loam to clay loam which passes at 10 to 14 inches into a brown, tough clay of the nature of a claypan. The surface soil usually contains a relatively large percentage of very fine sand. In places the surface soil is 20 inches deep.

The Calumet silt loam occurs within areas of Calumet very fine sandy loam on the higher terrace in the vicinity of Calumet. The surface is generally more nearly level than that of the surrounding soil and the run-off is a little slower, but the general slope is sufficient to give adequate surface drainage in normal years. The underdrainage is poor.

This soil is held in high esteem, but it is relatively unimportant in the agriculture of the county because of its small extent. Probably two-thirds of it is under cultivation, the remainder being used for pasturage. The soil is easily tilled and does not clod or bake badly. The same crops are grown as on the Calumet very fine sandy loam, and the soil is handled in very much the same manner. The range in yields is practically the same on the two types. Alfalfa seems to produce profitably over a longer period than on the very fine sandy loam.

Land of the Calumet silt loam is held at about the same prices as that of the very fine sandy loam type.

Improvement of the type can be brought about by methods suggested for the very fine sandy loam.

#### REINACH VERY FINE SANDY LOAM.

The surface soil of the Reinach very fine sandy loam consists of a brown or reddish chocolate brown very fine sandy loam 6 or 8 inches deep. The subsoil, to about 20 inches, is a dark chocolate red, heavy very fine sandy loam to light silty clay loam, below which it is a light chocolate red very fine sand to very fine sandy loam. In a few places a stratum of black clay is encountered between 15 and 20 inches. Areas of the latter nature would be mapped as McLain very fine sandy loam if of sufficient extent.

Only one area of Reinach very fine sandy loam is mapped in this county. It lies on the high terrace about 2 miles east of Calumet. The surface is nearly flat, but the drainage is good. This type differs from the Yahola very fine sandy loam in being situated on an older, higher terrace, above overflow, and in having a slightly darker surface soil.

The Reinach very fine sandy loam is all under cultivation. It is very productive and is well adapted to all crops of the general region. Yields are as good as on the Yahola very fine sandy loam, or even better. The land sells for \$50 to \$85 an acre, depending upon the state of cultivation and the improvements.

As mapped one area of Reinach loam is included with the Reinach very fine sandy loam. It consists of 6 or 8 inches of dark-brown to reddish chocolate brown loam, underlain by a reddish chocolate brown silty clay loam which passes at about 20 inches into a light chocolate red very fine sandy loam to very fine sand. The surface is flat, but there is enough general slope to afford good drainage. This is a highly prized soil, and except for one small pasture, it is all under cultivation. It is used chiefly for the production of corn, alfalfa, wheat, and oats. The yields compare favorably with those

of the best terrace soils. When this soil is cultivated properly crops withstand even the more droughty seasons in a remarkable manner. The land is held at \$50 to \$85 an acre.

#### LINCOLN VERY FINE SAND.

The surface 6 inches of the Lincoln very fine sand consists of a light-brown very fine sand, loamy in places. The subsoil is a pale-yellowish to grayish very fine sand. The subsoil is usually calcareous and the surface soil is often so.

This type occurs as alluvium along the Canadian River and its North Fork. The lower-lying areas are subject to frequent overflow, but the remainder of the type is seldom inundated. The surface varies from nearly level to dunelike. The soil as originally deposited by the rivers probably had a nearly level surface, and the present hummocky topography is the result of wind action. The type is well drained, on account of its loose, porous nature, but most areas nevertheless are not very droughty, as the water table lies close to the surface.

This is a rather important agricultural soil. Much of it is under cultivation. The uncultivated areas are used for pasture, though the growth of grass is rather scant. There are some clumps of wild plum and other bushes, and, immediately along the streams, some large timber, chiefly cottonwood, elm, oak, and hackberry, with some black walnut and persimmon. Considerable stock is grazed, and hog raising is carried on to some extent. The most important crop is corn, followed by kafir and oats.

Corn on the better areas yields an average of 10 to 20 bushels per acre and much higher yields are obtained in more favorable years. This soil is too light for the best results with oats, but good yields are obtained in seasons of sufficient rainfall. Kafir yields well. The soil is well adapted to sweet potatoes, watermelons, and cantaloupes, and these crops are grown to a considerable extent for home use and for sale at local markets.

This soil is very easy to cultivate, but it drifts badly in clean-cultivated fields, unless the supply of organic matter is maintained. The most successful farmers apply all the barnyard manure available.

Land of the Lincoln very fine sand is valued at \$40 to \$75 an acre; the lower prices being paid for dunelike areas and for land subject to most frequent overflow.

Cultural operations and cropping systems that tend to check drifting and which provide for the incorporation of organic matter should be more generally followed on this soil.

A few areas of Lincoln fine sand, owing to their small extent, are included with the Lincoln very fine sand. The soil is largely a fine



sand, with varying amounts of coarser material. It occurs in small isolated bodies on slight elevations in the first bottoms of the North Fork and probably represents earlier deposits of the river. The surface is nearly level to very gently undulating, the latter topography probably being the result of wind action. Drainage is rapid and complete, owing to the loose and open nature of the soil and subsoil. This is one of the last soils to be overflowed during high floods. Over half of it is used for pasture. The most important crops are corn and kafir. The yields vary with the season, but on the best areas the ordinary yield of either crop is 10 to 20 bushels. Some sorghum is grown. Fruit does well, especially peaches. This soil is early and well adapted to truck crops. It can be improved by the same means as the Lincoln very fine sand.

#### LINCOLN VERY FINE SANDY LOAM.

The Lincoln very fine sandy loam typically consists of about 10 inches of brown very fine sandy loam, overlying a light-brown to yellowish-brown very fine sandy loam, the lower part of which in places is of pale-yellow color and loose structure. The type is, however, extremely variable.

Many of the lower lying areas mapped with this type along the North Fork consist of light-brown very fine sand to loamy very fine sand, overlying a dark reddish chocolate brown clay loam, which passes into a dark chocolate brown clay like that of the Lincoln clay. Some of the higher lying areas along both rivers have a sandy clay or clayey sand subsoil. Along upper Boggy Creek the soil consists of 15 to 18 inches of dark-brown very fine sandy loam overlying alternating layers of brownish very fine sand and brown very fine sandy loam to light clay loam. Along Mustang Creek and a few of the smaller creeks in the eastern part of the county, the lower subsoil often has a reddish-brown cast. A few small areas of fine sandy loam lying along the Canadian River east of Union are included with the very fine sandy loam, as mapped.

The Lincoln very fine sandy loam occurs along the rivers and smaller streams in nearly all sections of the county. It is best developed along the rivers and along streams flowing through the uplands occupied by the Derby soils. It lies 5 to 10 feet above the streams and while nearly all subject to overflow, the higher lying portions are inundated only during exceedingly high floods. In general the surface is flat or, where cut by old channels, very gently undulating. The type is seldom covered with water for long periods and is well drained between overflows.

Excepting areas most subject to overflow, much of the Lincoln very fine sandy loam is under cultivation. It is very productive



and an important type in the agriculture of the county. The uncultivated areas support a good growth of pasture grasses. Along the stream banks there are belts of timber, chiefly cottonwood, elm, oak, and hackberry, with some black walnut.

The most important crop is corn. Considerable kafir, oats, alfalfa, and cotton are also grown. Hog raising and the grazing and feeding of cattle are the principal live-stock industries. The soil is well adapted to most of the truck crops, including melons and cantaloupes, and on most farms containing this soil it is used for farm gardens. Sorghum and popcorn are grown on many farms on a small scale.

Corn produces as consistent yields as on any other soil in the county and the crop is rarely a total failure from lack of moisture. It yields as much as 70 or 80 bushels per acre in very favorable years, and 15 to 25 bushels in normal seasons. Much of the type is too light in texture for the best results with the small grains, but on the heavier areas good yields are obtained. Wheat yields an average of 10 to 15 bushels per acre and oats 20 to 25 bushels. Kafir and the other grain sorghums produce good yields of both grain and fodder. Cotton yields one-fourth to one-half bale per acre. Alfalfa is grown quite extensively on the higher lying areas and does well. Sudan grass gives a total yield of  $2\frac{1}{2}$  to  $3\frac{1}{2}$  tons of hay per acre. Native grasses cut for hay yield from seven-eighths ton to  $1\frac{1}{4}$  tons per acre.

The Lincoln very fine sandy loam is easy to handle, only light implements being required. Much of the land has been used continuously for corn and in some cases begins to show deterioration. Most of the floods occur in the early summer and there is usually time enough after their subsidence to grow a grain sorghum either for fodder or grain if the planted crop has been damaged.

The price of land of the Lincoln very fine sandy loam depends upon the liability of inundation, the improvements, the location, and the surface configuration. Prices ordinarily range from \$40 to \$80 an acre, but a few farms are considered to be worth more.

The soil may be greatly improved by plowing under stable manure, green-manure crops, or weeds and crop residues. The rotation suggested for the Canadian very fine sandy loam would prove equally beneficial on this type.

#### LINCOLN SILT LOAM.

A Lincoln silt loam consists of a brown to dark-brown silt loam 15 to 20 inches deep, underlain by a brown to yellowish-brown or reddish-brown silty clay loam to light clay loam. The surface soil is quite high in organic matter, usually contains a relatively large percentage of very fine sand, and may be decidedly loamy in areas adjacent to very sandy soils. The subsoil may be a dark-brown clay

loam in the more poorly drained areas. Several patches of the Lincoln loam are included with the type as mapped.

The Lincoln silt loam lies along the rivers and the smaller streams, especially those flowing through the uplands occupied by the Kirkland soils. Along the rivers the type usually occupies the flatter areas back from the streams, but along many of the creeks it forms the only bottom-land soil. The surface is usually flat, and not as much dissected by old channels as that of the Lincoln very fine sandy loam. The type is subject to overflow, but many of the higher lying areas, including those east of Calumet, are inundated only once in 10 or 15 years. Flood waters rarely cover the surface for any great length of time and the drainage in general is good.

The Lincoln silt loam is an easily cultivated, productive soil. It does not clod badly unless plowed when wet, and even then the clods break down readily, forming a mellow tilth. A large proportion of the type along the rivers is under cultivation, and about 40 per cent of its area along the small streams also is farmed. The untilled areas support a sod of wild grasses, which on the larger tracts are usually cut for hay. Many cattle are pastured on the areas along the smaller streams. Belts of cottonwood, oak, hackberry, and elm fringe many of the streams.

The principal crops on this soil are corn, wheat, oats, alfalfa, and kafir. In years of normal rainfall and freedom from inundation corn yields 20 to 30 bushels per acre, wheat 15 to 30 bushels, oats 25 to 30 bushels, alfalfa 3 to 4 tons, and kafir 18 to 25 bushels. Small grains tend to grow too rank in wet seasons. Less cotton is grown than in former years.

Land of this type is held at practically the same prices as the Lincoln very fine sandy loam.

Much benefit should be derived from adopting a crop rotation similar to that suggested for the Canadian very fine sandy loam.

#### LINCOLN CLAY.

The Lincoln clay consists of 6 inches of dark-brown clay, underlain by a dark-brown to chocolate-brown clay which grades downwards into a brown to reddish-chocolate or salmon-colored clay. The subsoil is underlain at varying depths by a stratum of brownish sand and the lower subsoil itself is sandy in places. The material throughout the 3-foot section is calcareous. The soil when dry packs into a hard mass and cracks badly, and it is sticky and heavy when wet.

Areas of the Lincoln clay occur chiefly along the North Fork, where the largest areas are mapped west of Darlington. The type usually occupies the beds of abandoned stream channels or old lakes,

and is the first soil to be flooded when the streams overflow. The areas west of Darlington, however, which lie well back from the river, are overflowed only at higher flood stages. The type has a flat surface and is poorly drained.

In most of the smaller areas of this type, which lie nearest the stream, there is little grass, but a considerable growth of trees, consisting chiefly of cottonwood, elm, and oak. These areas are seldom farmed. Only a small proportion of the type back from the streams is used for crops, most of the areas being covered with a luxuriant growth of grass which is pastured or cut for hay. There is some salt grass on certain areas in the northwestern part of the county.

The most important crops grown on the Lincoln clay are corn, alfalfa, and wheat. In favorable years corn and wheat produce good yields, but wheat always has a tendency to grow too rank. Good yields of alfalfa are obtained on the better drained, higher lying areas, but the area devoted to this crop is small. Kafir and oats do well in favorable seasons.

For best results this soil must be thoroughly drained and dyked to prevent overflow. This improvement should be followed by the incorporation of organic matter to improve the physical condition and later by the adoption of a suitable crop rotation.

#### YAHOLA VERY FINE SANDY LOAM.

The Yahola very fine sandy loam is a reddish chocolate brown, very fine sandy loam, underlain at 8 to 10 inches by a chocolate-red very fine sandy loam to light silty clay loam, which grades into a light chocolate red very fine sand at about 20 inches. The lower subsoil often contains considerable clay.

In the areas along the Canadian River, away from the base of the uplands, the soil differs from typical in having a light chocolate red very fine sand or loamy very fine sand surface soil and a chocolate-red silty clay loam to silty clay upper subsoil, overlying a chocolate-red, clayey very fine sand to fine sand. In these areas small sandy hummocks occasionally occur. Along some of the smaller creeks in the northeastern part of the county the surface soil is in places quite silty.

The Yahola very fine sandy loam is most extensive along the Canadian River, John Creek, Deer Creek, and Six Mile Creek south-east of Calumet. Smaller areas are widely distributed over the county along the smaller creeks, especially those flowing through areas of Vernon soils, from which most of the Yahola soil material is derived. Where the type occupies nearly all the bottom land along the smaller streams it occurs in strips ranging in width from a few hundred feet to one-half mile. Along the Canadian River

it forms isolated bodies ranging in size from a few acres to 600 acres or more.

The surface of this soil is nearly flat, and only occasionally interrupted by old stream channels. The type is practically all subject to occasional overflow, but some areas along the larger creeks which have cut deep channels are seldom inundated oftener than once in 10 or 15 years. The type as a whole is well drained, but a few small areas north of the Canadian River in the south-central part of the county, which are almost entirely surrounded by sand dunes, are rather poorly drained. Such areas are used as pasture land.

The Yahola very fine sandy loam is productive, and important in the agriculture of the county. Probably 60 per cent of it is under cultivation. Along the creeks and in some of the narrower areas considerable timber remains, chiefly cottonwood, elm, oak, hackberry, and black walnut.

All the crops common to this region are grown, principally corn, oats, kafir, wheat, alfalfa, and cotton. Hog raising is the most important live-stock industry, but many cattle are raised and fattened on the larger areas. Fruits do well, and some surplus from home orchards finds its way to local markets. Watermelons and sweet potatoes give good yields.

Probably four-fifths of the cultivated area of this soil is devoted to corn, of which the yields are almost invariably good. Corn ordinarily yields 15 to 25 bushels per acre, oats 20 to 25 bushels, kafir 15 to 25 bushels, wheat 10 to 15 bushels, cotton one-third to one-half bale, and alfalfa from 3 to 5 tons. Sorghum and Sudan grass produce good yields of fodder.

The soil is handled in much the same manner as the Canadian very fine sandy loam. On many farms corn is grown continuously on the same land for years. The practice of spreading the stable manure on the fields is becoming more common and the practice is invariably beneficial.

The better land of the Yahola very fine sandy loam sells at \$40 to \$90 an acre, depending upon the improvement, the location, and the smoothness of the surface.

The adoption of a systematic rotation to include a green-manure crop, preferably a legume, would be beneficial. The rotation suggested for the Canadian very fine sandy loam should give good results. The areas of the Yahola very fine sandy loam along the Canadian River drift badly unless handled carefully.

#### YAHOLA SILTY CLAY LOAM.

The Yahola silty clay loam consists of a dark chocolate red to chocolate-brown silty clay loam, 6 or 8 inches deep, underlain by a chocolate-red to chocolate brownish red clay to silty clay. This



passes at 15 to 26 inches into a chocolate-red very fine sandy loam, to sandy loam. In places, especially in the smaller areas, the surface 2 or 3 inches may be a loam. The areas to the west of Okarche differ from typical in that the lower part of the 3-foot section is a sandy clay loam to sandy loam. The soil and subsoil are everywhere calcareous.

This type is closely associated with the Yahola silty clay loam, heavy phase. It is most extensive in the south-central part of the county west of Union, occurring in the Canadian River bottoms and along some of the smaller streams. Small isolated areas are found in the creek bottoms over the smoother sections of the county, reaching a rather important development to the west of Okarche. While this soil occurs in the first bottoms and is subject to overflow, the flood waters seldom reach the higher lying areas in the Canadian River bottoms. The surface is nearly flat, but there is a gentle slope toward the streams, and drainage as a whole is adequate.

Though rather inextensive this is one of the important soils of the county. Most of it is under cultivation, being used largely for the production of alfalfa. Other important crops are corn, wheat, and oats. Alfalfa yields 3 to 6 tons per acre per season. In ordinary seasons corn, with careful culture, yields 25 to 30 bushels per acre, wheat 12 to 15 bushels, and oats 20 to 30 bushels. The small grains tend to grow too rank in the wetter seasons.

The Yahola silty clay loam is handled in much the same way as the Yahola silty clay loam, heavy phase, but it does not generally require as heavy draft power and the soil does not bake as hard. When cultivated under the methods practiced by the more successful farmers it can be made very productive and drought resistant. The best farmers usually plow the soil deeply and cultivate it often. Incorporating more organic matter would improve its tilth.

Land of this type is held at \$50 to \$90 an acre, depending largely upon the location and the condition of the soil.

*Yahola silty clay loam, heavy phase.*—The Yahola silty clay loam, heavy phase, is a dark chocolate red to chocolate-brown clay which passes at about 6 inches into a lighter chocolate red clay. This is underlain at about 30 inches by a light chocolate red to chocolate-brown sandy clay. Both soil and subsoil are calcareous. The accumulation of organic matter in the surface soil in the lower lying areas gives it a color somewhat darker than typical.

This phase is most extensive in the Canadian River bottoms west of Union, where it forms nearly level to flat areas, with a general slope towards the river. It is subject to overflow at rare intervals, but these result more often from the floods in small tributary creeks than from flooding by the river. Most of the phase has good natural drainage, but a few small areas were originally swampy. Most of



these have been reclaimed by ditching. A small part of the phase, largely in the more poorly drained areas, supports a dense growth of timber, chiefly cottonwood, elm, and oak, with a heavy undergrowth.

Nearly all the Yahola silty clay loam, heavy phase, is under cultivation. While it is rather inextensive, it is important in that it is one of the best alfalfa soils in the county, about half of its area being devoted to that crop. The only other important crop is corn. Alfalfa produces 4 or 5 cuttings a year, with a total yield of 3 to 6 tons per acre. Corn yields as much as 40 to 50 bushels in favorable seasons. Wheat and oats, grown to some extent, give good yields. Hog raising is the most important live-stock industry, the stock being pastured on alfalfa. Cattle feeding is also engaged in on the larger farms.

Some of the alfalfa fields on this soil have been established as long as 10 years and are still giving profitable yields. Alfalfa is usually sown in the spring on a well-prepared seed bed. Much of the hay is baled. About one-half of the crop is fed to stock, the remainder being shipped out of the county. Care must be taken not to cultivate this soil when too wet, as it clods badly and bakes upon drying. The heaviest farm implements and draft power are required in plowing and tillage.

The best areas of the Yahola silty clay loam, heavy phase, are held at \$80 to \$100 an acre.

#### MILLER CLAY.

The Miller clay consists of a dark chocolate red clay, about 6 inches deep, resting on a lighter colored clay subsoil. Both soil and subsoil are calcareous. This type differs from the Yahola silty clay loam, heavy phase, principally in its heavier subsoil.

The Miller clay is most extensive along the small creeks west of Okarche. It usually occurs well up toward the heads of the streams, and the alluvium of which it is composed has been washed from Vernon areas. The surface is flat to nearly level and drainage is not as well established as in the Yahola clay areas, though most of the type farther down the streams has adequate drainage for cultivation. It is subject to occasional overflow.

This soil bakes badly upon drying after being plowed when too wet, but the clods work down readily when moist. It is a strong and productive soil and largely used for alfalfa and corn. Alfalfa produces 4 or 5 cuttings in the average year, with a total yield of 3 to 5 tons per acre. Corn yields 30 to 50 bushels in favorable years. The more poorly drained areas, few of which are under cultivation, support a good growth of grass and are used for grazing and hay production. Near the areas of the Vernon clay, eroded phase, there

occur a few small barren spots probably due to the presence of gypsum salts, as well as to the new and raw condition of the alluvium. The Miller clay is handled in about the same way as the Yahola clay. Much of it could be improved by artificial drainage.

#### DUNESAND.

Dunesand includes hummocky and hillocky areas of drifted sand, upon most of which vegetation has established itself, although some of the areas along both banks of the Canadian River are bare and are still being drifted about. Practically all the material forming the Dunesand has been blown up from the streams.

The Dunesand consists of 5 or 6 inches of brownish-gray to light-brown fine sand or very fine sand, underlain to a depth of 3 feet or more by a grayish or pale yellowish fine sand or very fine sand. In the depressions between the hummocks the darker colored surface sand is deeper. Near the Canadian River the lower part of the 3-foot section is reddish in places. The newer dunes, without vegetation, are very light colored at the surface.

Dunesand is encountered on the lower terraces or bottom lands along the Canadian River and its North Fork. The largest areas occur along the former and along the North Fork in the northwest corner of the county. The dunes for the most part range from 5 to 20 feet in height, though a few along the North Fork are higher. The principal vegetation is blackjack oak, cottonwood, some scrubby elm, wild plum, red haw, sandspur grass, and sand nettles. Practically none of the land is under cultivation. The older areas are used for grazing, but the grasses are of only fair feeding value.

#### ROUGH STONY LAND.

The term Rough stony land is applied to slopes that are too steep and rocky for cultivation. The areas north of the Canadian River contain patches of soil deep enough to support a scrubby growth of blackjack oak and a few varieties of coarse grasses, and if large enough to map separately would be classed with the steep phase of the Vernon very fine sandy loam. They afford fair pasturage in places and are used for grazing.

The areas south of the Canadian River are for the most part walls or bare ledges of red sandstone. In places the streams have cut gorges through these rocks 100 to 175 feet deep. Areas of this description are of practically no agricultural value.

#### SUMMARY.

Canadian County is situated near the center of the State of Oklahoma and lies within the Great Plains province. It has an area of 891 square miles, or 570,240 acres.

The surface is generally undulating to gently rolling, but small areas are more strongly rolling. The county is drained by the Canadian River and its North Fork and by tributaries to the Washita and Cimmaron Rivers. Drainage systems on the whole are well established. Elevations range from 1,160 to 1,590 feet above sea level.

The first settlers arrived in this region in 1889, and most of the land has been taken up under the homestead laws. The present rural population is quite evenly distributed. The county seat and largest city, El Reno, had a population of 7,872 in 1910. There are a number of towns, of which the most important are Yukon, Geary, Okarche, Union, and Calumet.

The county is well supplied with railroads, which give good communication with a number of large markets. The wagon roads in most places are good and nearly all the stream crossings are bridged.

Most of the grain produced is consumed at home or sold to local mills. Live stock is marketed at the city of Oklahoma.

The mean annual rainfall is about 32 inches and the precipitation is quite favorably distributed for the growth of crops. The mean annual temperature is 58.6° F. There is an average growing season of 212 days. Hot, dry winds from the south sometimes cause considerable damage to crops.

The agriculture of the county consists of general farming, combined with the raising of hogs and the raising and fattening of cattle. Some dairying is done on a small scale. Fruit growing is developed to some extent in parts of the county. At present no systematic crop rotation is practiced. The principal farm crops are corn, oats, wheat, grain sorghums, alfalfa, hay, and cotton.

Most of the farms range in size from 160 to 320 acres. Over 56 per cent of the farms are operated by the owners. Improved farm land sells for \$30 to \$80 an acre in the uplands and from \$60 to \$125 in the bottom lands.

In addition to Dunesand and Rough stony land, 26 different soils, classed in nine series, are represented in Canadian County. They may be divided into two broad divisions, upland and alluvial soils.

The upland soils may be classed in two groups, loessial soils and residual soils. The latter have been derived from the underlying red sandstones and shales of the Permian Red Beds and include the Kirkland and Vernon series. The loessial soils consist of material blown up by the winds from the bottom lands along the streams and are classed in the Derby series.

The alluvial soils of the second bottom or high terrace are grouped in the Canadian, Calumet, and Reinach series, and those of the first bottom in the Yahola, Lincoln, and Miller series.

The Kirkland soils, which have claypan subsoils, are devoted chiefly to small grains and grain sorghums. They are also fairly good corn soils, but in dry seasons this crop does not do so well as on the sandier soils. The Vernon and Derby soils are used more for general farming, except the Vernon clay and clay loam, which are devoted mostly to small grains and grain sorghums. Considerable cotton is grown on the lighter Vernon and Derby soils. Fruits, especially peaches, apples, and grapes, and such truck crops as melons, cantaloupes, and sweet potatoes, do well on these soils, and are grown on a small commercial scale in the eastern part of the county. The more rolling areas of these soils are used chiefly for grazing.

Of the important high-terrace soils the Calumet very fine sandy loam, the Canadian very fine sandy loam, and the Canadian clay, the first named is devoted mostly to small-grain production. The Canadian very fine sandy loam, which is extensive, is used for all the common crops, principally corn, oats, wheat, alfalfa, and kafir. The Canadian clay, while somewhat intractable, is a highly prized alfalfa soil, and most of the cultivated land is devoted to that crop. The Canadian loam is a good alfalfa and corn soil.

The Lincoln very fine sandy loam and silt loam and the Yahola very fine sandy loam are the most extensive first-bottom soils. They are used principally for corn, oats, wheat, and alfalfa. The sandier Lincoln soils are well suited to truck growing.

The Miller clay and the Yahola silty clay loam are devoted chiefly to alfalfa and corn. The former type in places is in too new and unweathered a state for the production of cultivated crops.

Dunesand includes the areas of drifted sand along the bottom lands of both the rivers. Much of it is old enough to allow vegetation to become established, but some areas in the vicinity of the streams are still being drifted. This land is used for grazing.

The Rough stony land includes slopes along the Canadian River and streams in the southwestern corner of the county that are too steep and stony for cultivation. It is used in places for grazing.



[PUBLIC RESOLUTION--No. 9.]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture "

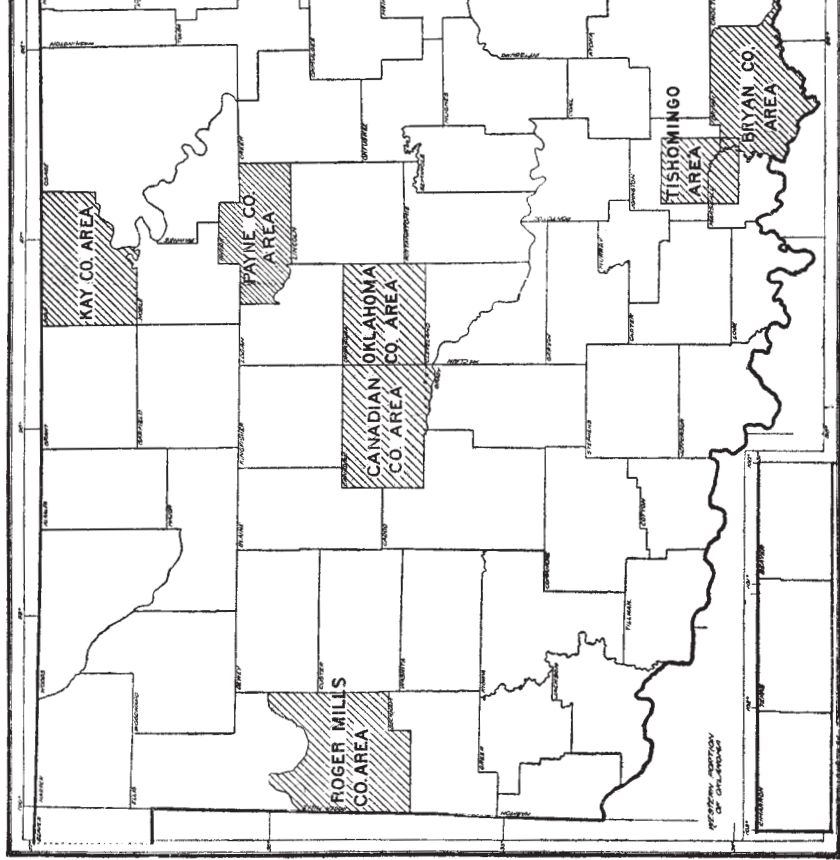
*Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That* public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the Congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]





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